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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

1919.

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ERRATA.

Page 185, line 6 from top, *for* Phoma *read* Phomopsis.
Page 189, line 12 from top, for *Diothella. D. populae* read *Dothiorella. D. populea.*
Page 190, line 5 from top, *for* Pcynidia *read* Pycnidia; line 7 from top, *for* depiscentia *read* dehiscentia; *for* copiossissimae *read* copiosissimae.
Page 195, line 2 from top, insert "&" between "Sacc." and "Schulz."
Page 197, line 2 from bottom, *for* emergently *read* emergent by.
Page 200, line 10 from top, *for* Fig. 22 *read* Fig. 23.
Page 201, line 11 from bottom, *for* unic. *read* univ.
Page 205, line 4 from top, *for* cercainas *read* cercanias.
Page 346, line 17 from top, *for* words *read* woods.
Page 392, line 7 from bottom, *for* Pylsowii *read* Pylzowii.

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BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 1 & 2] [1919

I.—FOOD AND FODDER PLANTS.

J. H. Holland.

The question of food, though always before us, has recently commanded more than ordinary interest because of the failure or uncertainty of many of the sources on which we have been accustomed to rely. It may be scarcely necessary to state that the subject is here treated in the sense that plants yield food for human beings and fodder for animals. The Natural Families first in importance for plants of this nature are *Leguminosae*, *Gramineae*, *Cruciferae* and *Rosaceae*, the "Pulses," "Cereals," "Vegetables," and "Fruits" predominating in each Family respectively. These will be considered first, and the remaining Families that come under review are selected as containing important products, as for instance, *Solanaceae* for potatoes and tomatoes, *Chenopodiaceae* for sugar beet and mangels, *Scitamineae* for the banana, *Palmae* for the coco-nut, &c. The plants of greater importance are given with the botanical name first, followed by the common names, the chief countries of production, brief details as to uses and other notes of interest; others of lesser value or so well known as to need no description are enumerated at the end of their Family with the position of scientific and common names reversed. The imports into this country are given in brackets immediately after the country of production, all figures being reduced to the nearest approximate number of centals and unless otherwise stated they refer to the year 1913, quoted from the "Annual Statement of the Trade of the United Kingdom," Vol. i. 1917. The approximate production of some of the principal crops in the United Kingdom is given in figures of the same denomination. Values are not stated as they are subject to fluctuation, and current prices are readily obtainable when required from the various official publications and trade journals. No attempt is made to include details of culture nor of diseases, as these subjects could not be properly dealt with in the space available; moreover, there are many valuable publications which treat with these matters; nor are the important issues of "vitamines" and "calories" taken into consideration. Full references to works quoted (under author's

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names) as authority for certain statements are given at the end of a Family or at the end of the complete paper. The references applying to individual plants are confined to the Kew Bulletin and to publications of the Board of Agriculture, referred to as **1.** (*Kew Bulletin*) **1a.** (*Kew Bulletin*, Additional Series), **2.** (Journal of the Board of Agriculture), **3.** (Leaflets), **3a.** (Special Leaflets).

Included in the paper are plants that have been the subject of enquiries at Kew, from time to time, in the search for new introductions or those capable of further development.

Leguminosae.

Lupinus albus, *Linn.*; White Lupin. **L. angustifolius,** *Linn.*; Blue Lupin. **L. luteus,** *Linn.*; Yellow Lupin and **L. termis,** *Forsk.*; Egyptian Lupin.

Annual plants of vigorous growth. Central and Southern Europe, Egypt, United States, Great Britain, though not of first importance in the two last-mentioned countries.

Seeds* used as food and fodder on the Continent and in Egypt. "Lupins are used to some extent for sheep in Norfolk and Suffolk, but they need to be fed very carefully and should only be given in quite small quantity at first" (Voelcker, Journ. Roy. Agric. Soc. England, lxx. 1909, p. 347); "their use for horses, cattle or pigs is not recommended and it would appear that on the whole the best use that lupins can be put to is to cut them green as fodder" (*idem*, l.c. xxiii. 1887, p. 306). "Utilized as pasturage, green feed or hay for sheep and goats; other animals will not eat them on account of the bitter taste," but "the hay, after soaking in cold water, is eaten by cows and horses" (Piper). The uncertainty in the use of lupins is due to a bitter principle contained chiefly in the seeds and to a lesser extent in other parts of the plant. Disembittering is recommended before feeding, and this may be effected by "soaking the seed in water for four hours with frequent changes of water, steaming for one hour and then extracting for two days with frequent stirring; in the latter operation the discoloured water is drawn off frequently and fresh water added." "Five pounds daily of this disembittered lupin seed may be fed to cows per 1000 lb. live weight" (U.S. Dept. of Agric. Farmers' Bull. No. 16, 1891, p. 12).

Ulex europaeus, *Linn.*; Gorse, Furze, Whin.

An evergreen shrub, about 6 ft. high when fully grown; "Fox tail" is an almost spineless variety, in favour as being easier than the ordinary to harvest. *Ulex nanus*, Forst., which grows about 2 ft. high, has softer shoots than those of *U. europaeus*.

Native of Britain; cultivated in Ireland, Wales, North of

* It may be advisable to refer to works on Lupin poison, and amongst recent researches reference might be made to "Lupines as Poisonous Plants," by C. D. Marsh, A. B. Clawson & H. Marsh, U.S. Dept. of Agric. Bull. No. 405, 1916, pp. 1–44; and "Lupines (*Lupinus* spp.)" in "Plants Poisonous to Stock," by H. C. Long (1917), pp. 29–32.

France, Brittany, &c., as a forage plant, suitable for all kinds of stock. It is recommended to cut every two years. Average yields in Brittany are from 10 to 12 tons of green stuff per acre, and plantations are usually maintained for 6 to 8 years but are sometimes kept down for 15 to 20 years (Inter. Rev. Agric. Rome, vii. Oct. 1916, p. 1407).

2. Dec. 1911, "Cultivation of Furze for Fodder and for Seed in France," pp. 759-762; Nov. 1912, "Gorse, Furze or Whins as a Forage Crop," pp. 670-671; Aug. 1915, "Gorse or Furze," pp. 455-456. **3a.** No. 34, 1915, "Autumn and Winter Fodder," "Gorse or Furze," pp. 3-4.

Cytisus pallidus, *Poir.*; Gacia blanca (La Palma). **C. palmensis,** *Hutchinson*; Tagasaste. **C. stenopetalus,** *Christ*; Gacia.

Shrubs 10 to 15 ft., native of the Canary Islands where they are cultivated as forage crops. The plants may be cut two or three times a year and 35 lb. of green branches chopped and mixed with 20 lb. of chopped straw is said to be a sufficient daily feed for a horse or cow. Seeds, especially of "Tagasaste" have been distributed from the Royal Gardens (beginning 1879) to various Colonial Governments, and very satisfactory reports of successful growth have been received from South Australia, Ootacamund (Madras), Natal, Cape Province (Union of South Africa), &c. The introduction, however, is only of importance to countries with a hot, dry climate, similar to that of the Canaries, in the Tropics or Sub-tropics, where other fodder plants are scarce and difficult to establish.

1. 1891, "Tagasaste (*Cytisus proliferus*, Linn. var.)" pp. 239-244; 1893, *Ibid.* var. *palmensis*, pp. 115-117; 1918. "Tagasaste and Gacia (*Cytisus* spp.)," pp. 21-25. **1a.** ix. 2 (1912) "*Cytisus*," pp. 179-180.

Medicago lupulina, *Linn.*; Black Medick, Minette, Trefoil, Yellow Trefoil, Yellow Clover, Nonsuch.

Annual. Europe, Africa, India, America—thoroughly established from Ontario to the Gulf of Mexico (Piper).

A forage plant commonly grown in pastures. The seed has been used to adulterate that of "Alfalfa," and this may account for the circulation at times of the empty legumes, of which a sample was submitted to Kew for identification in 1904, said to be used as a cattle food in the north of France, under the name of "Les Casses de Minettes." Another sample was received in the course of the present year, and they have also been noted in a mixture for feeding fowls.

Medicago sativa, *Linn.*; Alfalfa, Lucerne, Purple Lucerne, Burgundy Trefoil, Cultivated Medick, Bersim Hedjaz (Arabic).

Perennial, 1 to 2 ft. high. Cultivated under established conditions in Europe—France (Provence especially), Spain, Mediterranean region, Great Britain—England, chiefly Essex, Kent and Suffolk (these 3 counties growing upwards of 20,000 acres out of approximately 50,000 for all England), Wales (306

acres in 1917), Scotland (6 acres in 1917), Asia, Africa—Transvaal, Cape, &c., America and Australia. There is probably no other forage crop so widely grown, including tropical, subtropical and temperate conditions in arid, semi-arid, and wet regions. Used chiefly as fodder for cattle, horses, sheep and pigs, either green, as hay, as pasture, as ensilage—though this is not often necessary, more particularly in dry climates—and as meal, the dried stems and leaves ground up and mixed with grain or molasses. The flowers are good for feeding bees.

There are several popular forms—Provence, Turkestan, Arabian, Peruvian (var. *polia*, Brand, in which the whole plant is pubescent, giving a field of silvery-white appearance against the vivid green of the common form). "Provence Lucerne" is, perhaps, the one most generally grown, and this is the principal source of the commercial supplies of seed.

1a. ix. 2 (1911), pp. 186-190. **2.** Dec. 1896, "Cultivation of Lucerne in England," pp. 299-300, with table of acreage in various counties; Sept. 1897, "Value of Lucerne as a Fodder Crop," pp. 218-221; March, 1901, "Experiments with Lucerne," pp. 485-488; Dec. 1902, "On the Cultivation of Lucerne," pp. 343-344; July, 1905, pp. 225-227; May, 1906, "Lucerne and Trefoil Seeds," pp. 82-91; July, 1910, "Time of Cutting Lucerne," p. 305. **3.** No. 160, 1915, "The Cultivation of Lucerne."

The "Yellow Lucerne" (*Medicago falcata*, Linn.), is an indigenous Alfalfa of Europe and Northern and Central Asia, cut for fodder as a wild plant in certain parts; but it does not appear to be generally cultivated. "Heart Clover" or "Spotted Bur Clover" (*M. maculata*, Sibth., *M. arabica*, All.) is a useful fodder plant in the United States.

Melilotus alba, *Desr.*; Sweet Clover, Bokhara Clover, White or Sweet Melilot, Honey Clover, Siberian Melilot.

Biennial, about 3 ft. high. Europe, Asia, United States. Grown for pasturage, hay, soiling—but not commonly for this purpose, though "hogs eat it readily when thus fed," and silage. The "cumarin content makes animals avoid it until they have acquired a taste for its bitterness." (Piper). A good bee-feeding plant.

Trifolium alexandrinum, *Linn.*; Berseem or Bersim (Arabic).

Annual. Cultivated in Egypt and introduced to the S. United States. An important forage crop in Egypt, where it seems to suit the conditions as a cool season crop under irrigation, followed by cotton, &c., in the hot season, and is there preferred to "Alfalfa," which is also grown. It does not, however, appear to be able to compete with "Alfalfa" elsewhere.

Trifolium hybridum, *Linn.*; Alsike Clover, Swedish Clover.

Perennial, 2 ft. or so in height. S. Europe, Asia Minor, Algeria; cultivated in Sweden, Great Britain, United States, Canada. Grown for temporary and permanent pasture and for hay. It makes a good substitute in ground "sick" of red

clover. Except for colour the seeds of "White Clover" are not unlike those of "Alsike," and it is stated that "when the seed of this species was very expensive, bad samples of white clover were dyed green and mixed with the genuine Alsike Clover" (Hunter). Commercial seed can now be obtained from Canada.

See Journal Notes and Bd. of Agric. Leaflet No. 184, under White Clover.

Trifolium incarnatum, *Linn.*; Crimson Clover, Italian Clover, Trifolium (the seed is so distinguished from that of other clovers in the Trade).

Annual, 3 ft. high; there are three forms under cultivation—early, late and medium, and also a white flowered form. Southern Europe, Great Britain—southern counties more particularly, United States. Grown for pasturage and as a soiling crop. It is considered unsuitable for hay or feeding after flowering, as the hairs of the mature heads are liable to form "hair-balls" in the intestines, and the plant, moreover, gets too woody for hay when allowed to grow to maturity

2. Aug. 1906, "Italian or Crimson Clover," pp. 264-271.

3. No. 182, 1911, "Crimson Clover (*Trifolium incarnatum*)."

3a. No. 28, 1916, "Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs," pp 8-9.

Trifolium pratense, *Linn.*; Red Clover.

Perennial, a foot or so high, but usually cultivated as an annual or biennial, the land otherwise becoming "clover sick." Europe in general, including United Kingdom; Asia—Turkestan, S. Siberia, Himalaya, &c.; America, N. Africa. In America it is the most important leguminous crop, the area grown being about five times that of "Alfalfa" (Piper) and as a fodder crop, for soiling or for hay, in this country, it is of the greatest importance. The var. *perènne* is known as "Cow Grass," "Single Cut Cow Grass" or "Late Flowering Red Clover"; it stands better as a perennial and is more suitable for permanent pastures.

2. March, 1904, "Experiments in the Growth of Red Clover," pp. 499-501; March, 1906, "Red Clover and its Impurities," pp. 716-721; May, 1906, "Trials of Different Varieties of Red Clover," pp. 96-99: Nov. 1906, "A Russian Type of Red Clover," pp. 471-472.

See Bd. of Agric. Leaflet No. 184. 1913, under White Clover.

Trifolium repens, *Linn.*; White Clover, Dutch Clover.

Perennial, 1½ ft., Europe—Russia, Germany, Holland, Italy, United Kingdom, &c., United States, Canada, New Zealand. A fodder plant equal in importance to "Red Clover" and of greater value for pastures. "Ladino" is a variety (*latum*, McCarthy) grown in Italy, a strong grower, sometimes advertised as "Giant," "Mammoth" or "Colossal White Clover" (Piper). The seed has been found to be adulterated with that of "Clustered Clover" (*T. glomeratum*, Linn.), found in the south of England, the Mediterranean region, N. Africa, New Zealand, &c., and of *T. parviflorum*, Ehrn., native of Central and Southern Europe;

samples of both species having been grown and identified at Kew; they are both annuals of little or no value for fodder. "Suckling Clover" (*T. minus*, Relham—*T. dubium*, Sibth.), a common weed, has also been found as an aduiterant, but this plant, although much inferior to White Clover—price less than half—is sometimes grown in mixed pastures. The Customs Returns of imports of clover seed are given under the heading "Seed—Clover and Grass," and the Returns as to the production in the United Kingdom are included in "Clover, Sainfoin and Grasses under Rotation"—for figures, see end of *Gramineae*.

"Uganda Clover" (*Trifolium Johnstoni*, Oliv.) grown in pastures of Kikuya (5-6000 ft.), is recommended for hill pastures in other tropical countries, and seeds were distributed in 1899 to various Colonies, (*K.B.*, 1899, p. 137). "Shaftal or Persian Clover" (*T. resupinatum*, Linn.) is cultivated for forage in Persia and North-west India.

2. April, 1906, "White and Alsike Clover Seed and their Impurities," pp. 7-15; Dec. 1909, "Trials of Wild White Clover," pp. 713-718; Feb. 1916, *ibid.*, pp. 1063-1068; July, 1911, "Sale of a Weed Seed as White Clover," pp. 323-324; June, 1915, "Adulteration of White Clover Seed," pp. 253-254; Jan. 1917, *ibid.*, pp. 940-944; March, 1917, "Ordinary White Clover Seed versus Wild White Clover Seed," pp. 1202-1208; July, 1917, "Wild White Clover (*Trifolium repens*) for Artificial Grass Land," pp. 424-428.

3. No. 184, 1913, "Red, White and Alsike Clovers."

The following papers in the Journ. Bd. Agric. have reference to the genus *Trifolium*; Sept. 1901, English and Canadian Clover Seed," pp. 206-207; Oct. 1912, "The Study of Agricultural Seeds," pp. 529-541—"Perennial Red," "Alsike" and "White" Clovers; Jan. 1916, "Purchase of Clover Seed," pp. 997-998; May, 1918, "The Shortage of Clover Seed in Essex in 1917," pp. 176-179.

Anthyllis vulneraria, *Linn.*; Kidney Vetch, Ladies Fingers.

Perennial, about 6 in. or so in height: considerable variety is found in the colour of the flowers—red, white, yellow, &c., and various shades of these, but the forms with yellowish or reddish flowers are usually cultivated. A British plant, also found in other parts of Temperate Europe, N. Africa, &c.: cultivated, but not of special importance in America. As a fodder plant it is recommended for mixed pastures, especially in situations not good enough for "Red Clover." Sheep feed freely on this plant.

Hedysarum coronarium, *Linn.*; Sulla, Sainfoin d'Espagne, French Honeysuckle.

Perennial, 1 to 6 ft. high. Mediterranean region—S. Europe and N. Africa; United States, where it is fairly successful in S. Texas under irrigation; but cannot compete with "Alfalfa" (Piper). The plant is adapted to cultivation in hot, dry countries as it stands drought well. As a fodder plant it compares very favourably with "Alfalfa" in feeding value. The hay has been imported into this country from Algeria and Malta.

1a. ix. 2 (1911), p. 198.

Onobrychis sativa, *Lam.*; Sainfoin, Finger Grass.

Perennial, about 2 ft. high. Europe—France and southern parts, Great Britain—more especially in the south and east counties; United States. An excellent fodder plant for sheep especially. The ordinary variety is recommended for pasture and the var. *bifera*, "Giant" or "Double Yielding," for hay.

2. June, 1899, "Experiments in the Feeding of Sainfoin and Lucerne," pp. 39-44; June, 1906, "Sainfoin Seed," pp. 147-153; April, 1914, "Sainfoin (*Onobrychis sativa*)," pp. 43-46.

3. No. 280, 1916, *ibid.*, pp. 1-4.

Arachis hypogaea, *Linn.*; Ground Nut, Pea Nut, Monkey Nut, &c.

Annual, low-growing; the pods are formed on the stem above the surface in the ordinary way, but turn and bury themselves in the ground to develop. There are several varieties and numerous forms divided primarily into "bunched," in which the stems grow erect and compact; and "running" in which the stems are more or less procumbent. The most important source is the Colony of the Gambia (1509849)* in Tropical Africa, which also includes supplies of Rufisque (Senegal), Egyptian, Mozambique, &c.; Spain, British India, Japan, United States, and Australia, and it is grown in many other tropical and sub-tropical countries. Experiments on a small scale to cultivate this plant in England have so far proved unsuccessful, and in view of the climatic requirements the result could only be expected. An important source of food in the countries where grown and also used in this country, but more important here as a source of oil. They may be used as dessert after being roasted, and manufactured into pea-nut butter. The oil is largely used as a substitute for olive oil. In Marseilles, where the seeds are crushed on a large scale, the shells are ground and sold as "Soga Meal," for use mixed with molasses as cattle feed. The plant is a good fodder and may be used in the green state or dried as hay.

1. 1901, "Ground Nut or Pea Nut," pp. 175-200.

1a. ix. 2 (1911), pp. 201-206.

2. July, 1915, "Ground Nut Cake," pp. 308-313.

3a. No. 64, 1916, "Ground Nut Cake."

Desmodium tortuosum, *Swz.*; Florida Beggar Weed.

Annual, 3 to 10 ft. West Indies, United States—Florida, and other sub-tropical parts. A wild forage plant highly esteemed in the S. United States, giving a fodder of fine quality in large quantities; the haulms, though rather woody, are eaten by cattle and working stock of all kinds (*K.B.* 1896, p. 188); makes a fine quality hay that is relished by all classes of farm

* The imports to the United Kingdom are not readily available and this represents cental exported in 1913, less than 6 per cent. of which came into this country, the greater proportion being shipped to Germany and France (Col. Rep. Ann. No. 805, 1914, p. 8).

stock in Florida, where commercial hulled seed is wholly produced (Piper). Recommended by Kew in 1896 for cultivation in Australia, South Africa and the cooler parts of India.

Desmodium triflorum, DC., is a plant cosmopolitan in the Tropics, fed to cattle in India.

Lespedeza striata, *Hook. & Arn.*: Japan Clover.

Annual, 4 to 30 in. Japan, Manchuria, Corea, China, S. United States. In California it has spread over thousands of acres (Index Fl. Sinensis, i. p. 182). An excellent pasture plant and in situations favourable to full growth it may be cut for hay. "Spread in the United States from S. New Jersey westward nearly to central Kansas and south to the Gulf of Mexico," but "it is only in the lower Mississippi valley that it grows large enough to cut for hay, elsewhere being valuable only for pasturage" (Piper).

Cicer arietinum, *Linn.*; Chick Pea, Brown Gram or Black Gram, Bengal Gram, Horse Gram, Egyptian Pea, Idaho Pea. Garbanzo (Mexico, Spain).

Annual, 1 to 2 ft. India, Syria, Turkey, Spain, Bulgaria, Africa, Mexico, &c. The plant is grown chiefly for the production of seed, used for human food, considered one of the most nutritious of the pulses; the seeds are also good feed for horses, cattle, sheep, and poultry. The haulm is not suitable for fodder as the leaves contain an acid (oxalic chiefly) which in excess would be poisonous. "Leblebii" is a food made from the pea in Bulgaria and Turkey and said to be very useful in feeding children over 6 months old, especially when they have intestinal troubles (Inter. Rev. Agric. Rome, June, 1917, pp. 932-934).

The Customs Returns of Imports are included with those of "Dohl or Pigeon Pea" (*Cajanus indicus*) (q.v.). A considerable quantity of the Mexican produce is exported to the United States but the crop is mostly purchased in Mexico by special agents from Spain, who travel from hacienda to hacienda to buy (Bd. Trade Journ. May 18th, 1911, p. 361); the exports from Damascus go chiefly to Italy, France and Egypt (l.c. p. 360), from Beirut District, Turkey, to Egypt, Italy, United Kingdom and Malta (l.c. May 25th, 1911, p. 429), and large exports are also made by Morocco (l.c. June 1st, 1911, p. 478).

1a. ix. 2 (1911), pp. 207-208.

Vicia Faba, *Linn.*; Field Bean, Broad Bean.

Annual, 2 to 4 ft. China (1447017), Russia (75751), Germany (55384), British India (48295), New Zealand (17785), Netherlands (11401), Italy, Austria-Hungary, Turkey, Egypt, Morocco, United States, Canada, Mexico, &c., are the countries from whence imported, and in the same year (1913) the United Kingdom produced 3,040,989 centals. The Broad or Windsor Bean in various varieties is well known as a vegetable and the "Field" or "Horse" Bean (var. *equina*), including the cultivated forms "Heligoland," "Tick," "Red," "Mazagan," "Cluster," &c., is grown for feeding horses and cows.

2. Nov. 1910, "The Cultivation of Field Beans," pp. 631-636.

3. No. 268, 1913, *ibid.*, pp. 1-5.

Vicia sativa, *Linn.*; Vetch, Tare.

Annual, 3 to 5 ft., including several varieties, varying chiefly in size and colour of the seeds, but the two main kinds are usually referred to as "summer" and "winter" vetch. Europe, especially Russia (66338—seed) and Germany (26567—seed); Turkey in Asia (6710—seed), United States, United Kingdom and in general countries with a cool climate suitable for the "Field Bean," which is often grown with it as a support. In Scotland the crop includes Beans, Mashlum (mixed grain), &c., for fodder. Important as a forage crop—soiling, hay, or ensilage, for all of which purposes it is usually cut before the seeds mature. The "Hairy," "Russian," or "Siberian Vetch" (*Vicia villosa*, Roth.) is grown for a similar purpose, it is wild in Germany, Russia, &c., which countries export large quantities of seed for cultivation in the United States, where the grey-seeded variety of the Common Vetch is also largely grown (Piper); the plant is resistent to cold, heat and drought. *Vicia tenuifolia*, Roth, var. *stenophylla* is valued in Cyprus as a fodder plant (Bovill, Mus. Kew).

2. April, 1915, "Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs," pp. 30-31.

3a. No. 28, 1916, *ibid.*, p. 10. Food Production, No. 7, 1917, "Maintenance of Supplies of Hay and other Fodder Crops—Vetch Mixture Hay," p. 2.

Lens esculenta, *Moench.*; Lentil, Masur (India).

Annual, $1\frac{1}{2}$ ft. British India (168280), Russia (12756), Germany (69697), S. Europe, N. Africa, Egypt, Syria, and most Eastern Countries; cultivated experimentally in Nyasaland. Probably the oldest food plant grown. There are various forms, differing chiefly in the size and colour of the seed; two varieties "Verte du Puy" and "Petit à la Reine" are much esteemed in France as a vegetable (Vilmorin); in India, where the plant is grown as a winter crop, it is considered the most nutritious of the pulses (Watt, Church), and the dry plant is used as fodder. In this country the product for human food comes in whole or "split," the most important source, as indicated above, being British India. The seed has been noted in poultry food mixtures. "Ervalenta" or "Revalenta Arabica" is an invalid food, made chiefly of lentil meal (noted in Treas. Bot. (1889), Mus. Guide, No. 1; Comm. Prod. India (1908), and advertised at the present day). The lentil was introduced into this country in the sixteenth century (Loudon, Lawson), but although the conditions are suitable, the cultivation never seems to have become of any importance.

Lathyrus sativus, *Linn.*; Chickling Vetch, Grass Pea, Mutter Pea,* Indian Pea, Khesári or Kesári (Bengal), Dog-

* The true "Mutter" or "Mattar" Pea of India is *Pisum arvense*, the "Grey" or "Field" Pea.

tooth-pea,* Dent-de-brebis† or Sheep-tooth, Riga Pea,‡ Black Sea Pulse, Lakh, Lakhori.

Annual, 2 to 3 ft. high. No returns of imports into this country appear to be available; our principal source of supply is British India, and the figures are probably involved with those of Peas (see under *Pisum sativum*) from that country. The plant is cultivated in many tropical and sub-tropical countries, the seeds being used as food for both men and animals. The pods are sometimes eaten when green and the plant used as fodder. There is some danger in the use of this pulse for food; cases of poisoning are not uncommon and a disease known as "Lathyrism" is frequently produced—so far imperfectly understood; several hypotheses have been put forward as to the cause, and perhaps the simplest and most likely is that advanced by Major Buchanan after a special study of the causes. It is to the effect that the natives of India suffer more from this disease when compelled to live almost entirely on the pulse—an explanation that would fit many more so-called poisonous plants —and that paralysis is likely to occur when the proportion of Lathyrus reaches or exceeds half of the whole ration. The subject is too wide to enter upon here; it is fully discussed by Buchanan in "A Report on Lathyrism in the Central Provinces from 1896-1902" (Nagpur, 1904); Watt, Commercial Products of India (1908), "Lathyrism," pp. 705-706; Holmes in Pharmaceutical Journal, xxxvi. 1913, "A Poisonous Horse-Pea," pp. 795-796 and p. 837; Year Book of Pharmacy, 1913, pp. 276-278; Long in "Plants Poisonous to Live Stock" (1917), pp. 27-29.

"Tangier-Pea" (*Lathyrus tingitanus*, Linn.), an annual, native of North Africa, is grown for forage in Algeria.

1. 1894. "Lathyrus Fodder (*Lathyrus sativus*)," pp. 349-352.

Pisum arvense, *Linn.*: Field Pea, Partridge Pea, Dun Pea. Grey Pea, Maple Pea.

Annual, 3 ft. or thereabouts. Probably native of S. Europe; cultivated under several varieties in most temperate countries (for trade sources see under *P. sativum*), and more or less throughout the United Kingdom (production in 1913—2133104 centals), where the counties of Essex, Kent, Lincolnshire, and Suffolk each grow more than 10,000 acres. Peas used for feeding stock, poultry, game and pigeons, and the haulms as fodder. In Idaho it has been found that "hogging off"—turning pigs on to the field—is a practical and convenient method of harvesting and feeding pigs (Univ. of Idaho, Agric. Bull. No. 92, 1916, pp. 6-8).

Pisum sativum, *Linn.*; Garden Pea. Blue Pea.

Annual, 2 ft. and upwards; cultivated under numerous

* A sample said to be known in commerce under this name, imported from Odessa to Hull; identified at Kew as *L. sativus*.

† So-called by Vilmorin (Pl. Potageres, p. 283).

‡ Sample in Museum, Kew, of a large white-seeded form.

varieties as a vegetable in the green pod and on a field scale when the ripe seeds are harvested. "Harrison's Glory" is a variety grown largely in Suffolk, the seeds of which are put up into packets for sale as food. Pea canning is an important industry in the United States and the refuse is recommended there for forage. The Customs Returns (for 1913), as referring to the two species, are given below:—British India (1077832), Germany (248942), New Zealand (208312), Netherlands(201062), Russia (173734), Japan (167104), Canada (6462), Australia (6294), United States (3987), Belgium (1657), Chili (851), China (168). The foregoing figures refer to whole peas, and in addition Germany supplied 102,715 centals of split peas.

2. April, 1915, "Suggestions for the Cultivation of Catch Crops and Home Grown Feeding Stuffs—Peas," pp. 29-30.

3a. No. 28, 1916, p. 8.

Glycine Soja, *Sieb. & Zucc.*; Soy Bean, China Bean, Japan Pea, White Gram, &c.

Annual, 1½ to 4 ft. high. Imports for the present are prohibited but the important sources are Russia (875526), China (816032), Japan (43209) and also cultivated in India, America, South Africa, and under experiment in several British Colonies. Considerable interest has recently been taken in the cultivation in England, but results of experiments made at Cambridge, Midland Agricultural College, South Eastern Agric. College, Wye, &c., go to show that no variety so far has been found that can be relied on to produce seed here. The varieties tried (16), of which there is a small sample of each in the Kew Museum, were obtained by the Board of Agriculture from North Japan (Exp. Station, Hamadate village), together with samples of the soil they grew in, for the purpose of inoculating the soil here. Several Manchurian varieties have been tried with like result. The variety "Early Tennessee," grown at Wye College, Kent, in 1910 is reported to have produced well-filled pods (**2** *seq.*, March, 1916, p. 1287). Specimens of the plant of a North Manchurian variety grown in Regent's Park were shown at the recent food economy exhibition of the Ministry of Food at the Institute of Hygiene (Nat. Food Journ. March 13, 1918). The beans are an important food in the East: used like peas in this country, as a vegetable, in soups, &c. In Japan and China they are largely used in the preparation of the sauce known commercially as "Soy," and they make there a preparation used as a substitute for milk, and from this a food product called "Tofu," which in turn forms the basis of the bean cheeses of Japan. The meal in this country is used in the manufacture of biscuits and in making a bread for special use in diabetes; but the principal use here is for the extraction of the oil of which the beans contain about 18 per cent., suitable for soap-making and in general as a substitute for cotton seed oil, the residue being a valuable cattle feed. The plant is grown in the United States as a forage crop—soiling, hay and ensilage.

1a. ix. 2 (1911), pp. 211-214.

2. May, 1909, "Soy Beans," pp. 128-129: Dec. 1909, "The

Soy Bean," pp. 735-739; April, 1912, "Cultivation of Soy Beans in Britain," pp. 33-35; March, 1916, "The Soya Bean," pp. 1286-1287; Oct. 1916, "Extracted Soya Meal Poisoning," pp. 691-692.

Mucuna aterrima, *Holland,* in *Kew Bull.* Add. Ser. ix. p. 216; Bengal Bean, Mauritius Bean. **M. Deeringiana,** *Holland*; Velvet Bean, Florida Velvet Bean. **M. nivea,** *DC.*; Lyon Bean.

All annual and vigorous growing climbers cultivated in the tropics for forage. The most important plant is the "Velvet Bean," largely grown in Florida, Philippines, Transvaal, &c. Used in a green state and as hay for feeding stock. The beans are fit only for feeding animals, for which purpose they may also be ground into meal and used like cotton-seed meal.

1. 1898, "Florida Velvet Bean," pp. 207-208.

1a. ix. 2 (1911), "*Mucuna*," pp. 216-220.

Phaseolus aconitifolius, *Jacq.*; Moth Bean (India).

Perennial or annual, 1-2 ft. India, Ceylon, &c. Cultivated on a large scale in India for the beans used as food and the green pods are also used as a vegetable. The plant is an important fodder.

Phaseolus angularis, *Wight*: Adzuki Bean (Japan), Manchuria White and Red Bean.

Annual, 2½ ft. Japan, Corea, China, Manchuria. This bean appears to have been coming into the market recently in quantity. Trade samples have been submitted to Kew for name as "Dainagon Azuki Beans." They are an important human food in the countries mentioned, cultivated for the purpose.

Phaseolus calcaratus, *Roxb.*; Rice Bean.

Annual, trailer, 3 to 6 ft. India, Burma, China, Japan, Java, Mauritius, Philippines, &c. Cultivated for the beans, which are used as food. There are several varieties, with brown, black, maroon, and grey-marbled seeds. Not recommended in the United States either as a forage crop or for human food; the habit and shattering of the seed make the plant difficult to harvest (Piper).

Phaseolus lunatus, *Linn.*; Lima, Burma, Paigya, Rangoon or Java Bean, Duffin Bean, Small Mauritius Bean, Butter Bean, Madagascar Butter Bean.

A tall biennial, habit of the Runner Bean, climbing upwards of 8 ft., according to variety. Commonly cultivated in the Tropics and warm countries under many varieties, which vary especially in the colour, size and shape of the seeds—white, black, brown, reddish and mottled. The "Lima Bean" is largely grown in California (Irish), and other trade sources are chiefly British India and Madagascar (for imports see under *P. vulgaris*). The "Madagascar Butter Bean" is the one commonly sold by grocers, and also the small white seeds have been sold as "Haricot," "Rangoon Haricot," or "New

Haricot" beans. The other kinds mentioned under common names, with chiefly coloured seeds, are imported for feeding cattle. The white seeds are usually considered safe for food, but suspicion is always justifiably attached to coloured seeds, which have been found to contain undue proportions of prussic acid. In the Kew Museum there is a wide range of these beans which have been the cause of poisoning cattle, investigated by the Board of Agriculture. The Government chemist has found that "excepting that the white beans contain the lowest quantity (0·105 per cent.), the dark-brown (0·33 per cent.) and the black (0·32 per cent.), the highest quantity of prussic acid, it is not possible to draw the conclusion that there is any close relation between colour and amount of prussic acid in the beans." Particulars of the poisonous properties of this bean are given in the papers referred to below. The young pods may be cooked like "French beans," and the plant is an important fodder in India. Enquiries have recently been made as to whether this species will succeed in England. It was introduced to this country in 1779 (Loudon, who describes it as a "bark stove annual"), and although it may grow during the summer months out of doors it could not be depended upon to ripen seeds in the open.

2. March, 1906, "Poisoning of cattle by Java Beans," pp. 742-746; April, 1906, *ibid.*, pp. 52-53; March, 1908. "The Poisonous Properties of the Beans of *Phaseolus lunatus*," pp. 722-731.

Phaseolus Mungo, *Linn.*; Urd Bean (India), Black Gram.

Annual, 1 to 4 ft. a variable plant. Tropical India, Africa, &c. In India one of the most important crops; the green pods and ripe seeds used as food and the plant as fodder.

Phaseolus radiatus, *Linn.* (*P. aureus,* Roxb.); Mung (India), Mung Pulse, Green Gram, Golden Gram, Jerusalem Pea (Jamaica).

Annual, 1 to 2 ft., a variable plant. India, where there are three leading varieties under cultivation, the "Mung" or "Chegt Mung" (var. *typica*), seeds green; "Sona Mung" (var. *aurea*), seeds yellow, the most esteemed form and "Krishna Mung" (var. *grandis*), seeds black, the least esteemed form (Prain, Journ. Asiat. Soc. Bengal, lxvi. 1897, p. 422). Grown also in Malaya, Tropical Africa, &c. Seed used for food and fodder and the straw is also used for fodder.

Phaseolus vulgaris, *Linn.*; Haricot Bean, Kidney Bean, French Bean.

Annual, a foot or so high, including upwards of 200 varieties cultivated in many parts of the world—tropical, sub-tropical and temperate. The principal sources of "Haricot Beans" are Madagascar (80438), British India (76048), France (36849), Germany (35661), Chile (28392), Austria-Hungary (27305), Belgium (24575), Roumania (9609), Italy (5902), Netherlands (5241), United States (2900), Russia (1288), and Japan (1232).

The seeds may be white, black, yellow, brown, red, and

various shades of these colours, or variegated. It is usually the white kinds that are used for human food, but certain coloured ones, as, for instance, "Canadian Wonder" are also considered good as "shell beans" in America—that is when the beans are in a soft, green condition, but large enough to shell. "Boston Baked Beans" are prepared from the variety "Navy," with a white seed, much used in baking and for stock food, for which purpose it is grown largely as a field crop in America; the pods are inferior for cooking purposes (Irish); "Golden Cranberry" is stated by the same author to be universally cultivated. A coloured bean, "Brown Holland" or "Dutch Brown" is grown in Holland in large quantities for food, the ripe seed being used: it is not suitable for use in the pod. Experiments were made with success in this country at Kew and at Wisley in 1916, and the Royal Horticultural Society distributed for cultivation a ton of these beans obtained from Holland in 1917 (Journ. Roy. Hort. Soc. xlii. 1917, p. 433). Recently some coloured beans, chiefly from Brazil and Chile, have been coming into the market, and from samples submitted to Kew for identification, they are all apparently varieties of *vulgaris*, intended for feeding to stock. In some cases they have been reported as unwholesome. Although there is no reason so far to suspect the varieties of this species as being poisonous in the same way as those of *lunatus*, careful experiments should be made in feeding with a new bean, and under no circumstances should a whole ration be given at one time. In reference to recent imports of Brazilian beans for use as cattle food it is reported (Journ. Bd. Agric. *seq.* p. 124) that in the beans examined (brown in colour and about the size and shape of a small haricot bean) "there was complete absence of any poison and the analysis showed that the beans should prove of good feeding value" and, "that the trouble which has arisen in the use of this bean has been due to the fact that farmers have not boiled, steeped, or soaked the meal previous to feeding." With this proviso the beans are considered excellent for feeding stock. Boiled and mixed with hot mash is recommended, preparatory to feeding poultry, which otherwise refuse to eat the bean. The French Bean is usually grown in this country for the green pod, amongst which two well-known varieties are "Canadian Wonder," above mentioned, and "Ne Plus Ultra." The name "Butter Bean" here refers to yellow-podded varieties, including "Mont d'Or," "Golden Wax," "White Algerian," or "Tall White Algerian Butter Wax" (Vilmorin), &c.

The "Scarlet Runner Bean" (*Phaseolus multiflorus*, Willd.), is a perennial plant of Mexico, but usually grown as an annual for the green pods only as a vegetable. Suggestions have been made to use the haulms of this plant in hard times for feeding cattle, rabbits, &c., but it may be said, apart from the uncertain value as fodder—though the roots are poisonous—there is no record at hand of the haulm being injurious, the small quantity available before the plants finish bearing, when the dry, bare bines would be poor stuff for feeding, makes it scarcely worthy of consideration.

1a. ix. 2 (1911), "*Phaseolus*," pp. 224-228.
2. Jan. 1919. "The Use of Brazilian Beans for Feeding Purposes," pp. 1239-1240.

Vigna Catiang, *Walp.*; Cow Pea, Catiang Bean.
Annual, climbing upwards of 6 ft. Tropics, Sub-tropics and countries with long hot summers. The green pods and ripe seeds are used everywhere as food and the plant as fodder. There are many varieties under cultivation, differing in size and colour of the seed and in habit, the white seeded kinds being generally considered the best. A form with long pods is sold by market gardeners in India (Watt) and the young pods of "Dolique Mongette" are eaten in France and Italy (Vilmorin) as a substitute for "French Beans." The Cow Pea is one of the standard forage crops, for hay and pasture, in the S. United States (Lyon and Hitchcock, U.S. Dept. Agric. Bur. Pl. Ind. Bull. No. 59, 1904, p. 47). As a forage crop it is recommended in N.S. Wales for cultivation with "Maize" (*Zea Mays*) up the stems of which the vines climb (Hadfield, Agric. Gaz. N.S. Wales, Aug. 1914, p. 657), and it is similarly grown in India (Watt). For feeding pigs it is estimated that an acre of ripening cow-peas will pasture 15 to 20 animals for several weeks (Queensland Agric. Journ. vi. 1900, p. 269).
1a. ix. 2 (1911) pp. 228–230.

Dolichos biflorus, *Linn.*; Horse Gram, Kulti or Kulthi (India).
Annual, 3 ft. India, Burma, Ceylon, Tropical Africa, etc. The imports into the United Kingdom are in the main probably from British India, the returns not being readily separated from those of other kinds of "gram." Important as food and fodder. Church states that the long continued use of the beans as food is regarded as injurious; they are reputed in some districts to cause œdematous swellings.
1a. ix. 2 (1911) p. 234.

Dolichos Lablab, *Linn.*; Lablab Bean, Indian Butter Bean, Hyacinth Bean, Bonavist Bean (West Indies).
Annual climber, 10 to 15 ft. There are two well marked varieties—one with white flowers and white seeds, the other with violet flowers and seeds dark-brown to black. Tropical Asia, Africa, and America. Used as food, both the green pods and ripe seed. Dr. Leather (Agric. Journ. India, i. 1906, "Cyanogenesis in Plants," p. 224) has found prussic acid in the seeds; but some seeds (brown) recently submitted to Kew for identification were found by Dr. Voelcker to be free from any cyanogenetic glucoside.
1a. ix. 2 (1911) pp. 234–235.

Cajanus indicus, *Sprenq.*; Pigeon Pea, Congo Pea, Angola Pea, Dhol or Dhal (India), Bombay Tare.*
Perennial, usually grown as an annual, 8 to 9 ft. The principal source of supply to the United Kingdom is British

* Seed submitted to Kew, for identification, under this name.

India (639060) [see also "Chick Pea, *Cicer arietinum*], also cultivated in Tropical Africa, Venezuela, Madagascar, Philippines, Mauritius, West Indies, Guiana, Australia, and other hot countries. Used as food—the tender green pods, the young green peas, and the ripe ones whole, split or ground into meal. The young shoots and the leaves stripped off at the time the peas are harvested, make good fodder for cattle. The plant is specially grown in Bengal and Assam for feeding the lac insect, and in Madagascar and the Antilles for feeding silkworms.

1a. ix. 2 (1911) pp. 236-237.

Ceratonia Siliqua, *Linn.*; Locust Bean, Carob Bean, Algaroba (Spain).

A tree, 15 to 25 ft. high. Native of S. Europe and the Mediterranean region; wild and cultivated in N. Africa; naturalized in certain parts of India and cultivated in the West Indies, &c. Principal trade sources of the pods are Cyprus (459131), Portugal (152452), Turkey in Asia (58336), Algeria (21470), Italy (2174). The beans are an important food for stock, including cattle, horses, and pigs. Trees begin to bear fruit after about 3 years from grafting on stocks about 2 years old.

1a. ix. 2 (1911) pp. 261-263.

Prosopis juliflora, *DC.*; Mesquit Bean, Algaroba, Honey Locust.

A deciduous tree up to 50 ft. high. Native of the West Indies and Central America; introduced to many British Possessions, including Australia, South Africa, India, West Indies, &c. Seeds obtained from the Mohave Desert, California, by the Foreign Office, were distributed from Kew in 1875. The best reports of success in establishing trees came from India—Punjab and South Australia (see Kew Rep. 1879). The pods are a good food for cattle, horses and pigs, though death has resulted on occasion after eating damp or undried pods, owing, it has been suggested, to the germination or swelling of the seed in the stomach. They are an important article of food with the Indians and Mexicans, who grind them into flour for baking purposes. In Hawaii, where the plant has been introduced, it appears to have become thoroughly naturalized, growing wild along the sea coast, and it has been the means of enabling this island to develop an important trade in "Algaroba Honey" (See "Hawaiian Honeys," by Van Dine and Thompson, Hawaii Exp. St. Bull. No. 17, 1908, pp. 8-9), doing, it would seem, what "Logwood" (*Hæmatoxylon campechianum*) has done for Jamaica in producing its famous "Logwood Honey."

1a. ix. 2 (1911) p. 285.

Enterolobium Saman, *Prain* (*Pithecolobium Saman*, Benth.); Guango, Rain Tree.

A large deciduous tree up to 60 ft. high. Native of Tropical America, introduced to the West Indies, India, West Africa, Queensland, &c. In Jamaica it was introduced from the mainland and was reported in 1878 to have then become naturalized

in all the dry regions. From this Colony seeds were obtained and distributed by the Director, Kew, to other Colonies and India. In reference to India, Sir G. King in 1878 reported the tree as "a more hopeful source of cattle fodder than the Carob" (*Ceratonia Siliqua*) (see Kew Rep. 1878). The mature pods are good fodder for stock, for which purpose they are largely used in Jamaica. In many countries where this tree has been introduced it is principally valued as an ornamental shade tree.

1a. ix. 2 (1911) pp. 300-301.

"African Locust Beans" (*Parkia biglobosa*, Bth. & *P. plicoidea*, Welw.), West Africa; pulp of the pods eaten (*K.B.* 1908, pp. 314-315; Add. Ser. ix. 2, pp. 281-282).

"Bambarra Groundnut" or "Mozambique Gram" (*Voandzeia subterranea*, Thouars), Tropical Africa; seed used as food (*K.B.* 1906, pp. 68-70).

"Chiga Bread" (*Campsiandra comosa*, Benth.), a tree of tropical South America, from the seeds of which a flour is obtained, used for making bread (*K.B.* 1889, pp. 71-72).

"Doi" or "Dohi" (*Kerstingiella geocarpa*, Harms.) of Dahomey and Yoruba; beans used like those of "Haricot" (*K.B.* 1912, pp. 209-213).

"Birds Foot Trefoil" (*Lotus corniculatus*, Linn.), Britain, a small plant in mixed pastures, eaten by all kinds of stock.

"Fenugreek" (*Trigonella Foenum-graecum*, Linn.), native of the Mediterranean region, cultivated in Turkey and India, seeds used as a condiment for stock.

"Guar" (*Cyamopsis psoralioides*, DC.), India, where the plant is cultivated both as a green forage crop and for the seed used as a cattle feed.

"Kuzu" or "Kudzu" (*Pueraria Thunbergiana*, Bth.), of Japan. A large climber, 40 to 60 ft. in length, with large tuberous roots from which a starch is made for use as food; the leaves are fed to cattle. In the United States it has recently attracted some attention as a forage crop; "the leaves and cured hay are eaten freely by horses and cows and for permanent hay fields, especially in the south it is likely to become of some importance" (Piper). Some enquiries were made at Kew during 1917 as to the suitability of this plant for cultivation in England. It is not probable that it would be of any value here as the seeds do not ripen freely outside Japan, and cuttings or layers, the alternative method of propagation, would be costly on a field scale; moreover, the plant will not stand frost and the experience in the United States (*idem*) is that the field does not produce the best results until the third year.

"Prairie Turnip" (*Psoralea esculenta*, Pursh.), of North West America, where the tuberous roots are largely used as food by the aborigines.

"Serradella" (*Ornithopus sativus*, Brot.), of S. Europe and Morocco, grown for forage in Spain, Portugal, France, Germany, &c.

"Sword Bean" or "Jack Bean" (*Canavalia ensiformis*, DC.), cosmopolitan in the Tropics; cultivated in many parts for the young pods, eaten like "French Beans." The beans are some-

times eaten, the white kinds being the best, though they are considered indigestible unless the outer skin is removed. In Hawaii the green plant has been found to be both palatable and nutritious for feeding dairy cows and swine, and the green beans and Sorghum have been fed with excellent results (Hawaii Exp. St. Bull. No. 23, 1911, pp. 19, 20).

Tetrapleura Thonningii, Bth., of West Africa; pods used roasted and ground, in the preparation of black soup, a common native food.

"Yam Beans" (*Pachyrrhizus angulatus*, Rich. and *P. tuberosus*, Spreng.), cultivated in the Tropics; the tuberous roots are edible and a starch is obtained from them (*K.B.* 1889, pp. 62-63 and p. 121; 1895, pp. 47-48, with analyses of tubers and seeds said to contain a poisonous resin).

"Yeheb" (*Cordeauxia edulis*, Hemsl.), a small bush found in great quantities in the "Haud" or waterless desert of Somaliland, where the nuts form the staple article of food of the poorer classes of native (*K.B.* 1908, pp. 36-44; 1910, pp. 398-400).

The following may be referred to for general information on the Order:—

"Garden Beans Cultivated as Esculents," H. C. Irish in 12th Report, Missouri Botanic Garden, 1901, pp. 81-165; pls. 38-47.

"Inoculation of Leguminous Plants," Journ. Bd. Agric. xii. Feb. 1906, pp. 641-659.

"American Varieties of Garden Beans," W. W. Tracy, U.S. Dept. Agric. Bureau Plant Industry, Bull. No. 109, 1907, pp. 1-155; pls. i.-xxiv.

"Leguminous Crops for Hawaii," F. G. Krauss, Hawaii Exp. St., Bull. No. 23, 1911, pp. 1-31, illustrated.

"Some New or little-known Leguminous Feeding Stuffs," in Bull. Imp. Institute, xi. 1913, pp. 230-243.

"Five Oriental Species of Beans," C. V. Piper and W. J. Morse, U.S. Dept. Agric., Bull. No. 119, 1914, pp. 1-32.

"Leguminous Crops in Desert Agriculture," A. Howard and L. C. Howard in The Agric. Journal of India, xii. Jan. 1917. pp. 27-43.

"The Peas and Beans of Commerce," Bull. Imp. Inst., xv. 1917, pp. 503-544.

Gramineae.

Paspalum dilatatum, *Poir.*: Hairy-flowered Paspalum, Large Water Grass, Leichardt Grass, Golden Crown Grass.

Perennial, 2 to 4 ft. and sometimes 6 ft. in height. Brazil, Argentine, Uruguay; distributed to the Gulf States and Florida. Introduced to Australia—New South Wales, Queensland, Victoria, and West Australia; India, British East Africa, Natal, and New Zealand (but is reported not to stand the winter here) and found also in Porto Rico, Mauritius, and Straits Settlements. An excellent hay and pasture grass, suitable for warm countries; recommended in countries with mild winters, to be grown with "Cocksfoot" (*Dactylis glomerata*, Linn.), or similar grass that grows in a cold climate.

1. 1902, "An American Fodder Grass," pp. 1-4.

Amongst other Paspalums for fodder may be mentioned (see *K.B.* 1894, Trop. Fodder-Gr.) "Sour Grass" (Jamaica), "Green Grass" (Singapore) (*P. conjugatum*, Berg.) 1 to 2 ft. high, found in Tropical America, Africa, Ceylon, East Indies, &c. "Silt Grass," "Water Couch" (*P. distichum*, Linn.) of Tropical America, Australia, &c., "Ditch Millet" or "Kodo Millet" (*P. scrobiculatum*, Linn.) of India and other tropical parts of the East; recommended for pasture and hay, but said to be more or less poisonous to animals at the time of ripening.

Panicum frumentaceum, *Roxb.* (*P. Crus-galli*, Linn., var. *frumentaceum*, Trimen. *Echinochloa frumentacea*, Link); Japanese Barnyard Millet, Sanwa Millet (India), Billion Dollar Grass (America).

Annual, 2 to 4 ft. Japan, India, Africa, Southern States of America, and many other warm countries. Seed used for food, especially in the East; though Church states that it "does not take a high place among the millets for food." The plant, perhaps best cut green, is cultivated in some countries for fodder.

Panicum maximum, *Jacq.*; Guinea Grass.

Perennial, 3 to 6 ft., native of Tropical Africa. Cultivated in many tropical countries, including Brazil, Cuba, Jamaica, and other parts of the West Indies, India, Gulf Coast, and Florida. One of the best fodder grasses in the Tropics; recommended as a soiling crop and cut before the stems get hard and woody, may be used as hay and silage.

1. 1894, pp. 382-383.

Panicum miliaceum, *Linn.*; Broom Corn Millet, Chena or Indian Millet.

Annual, 2 ft., but a variable plant. India, Ceylon, China, Japan, Persia, Egypt, Russia, America, &c., where it is cultivated for the seed used as food, and the plant more or less for forage.

Panicum muticum, *Forsk.* (*P. barbinode*, Trin.); Para Grass, Mauritius, Scotch, Water, or Buffalo Grass.

Perennial, 3 to 4 ft. high. A tropical species known in Brazil, West Indies, Florida, Gulf Coast, Curaçao, Ceylon, Mauritius, Bengal, Australia. It is largely used in Brazil, the chief fodder grass of Ceylon, and in general it is regarded as one of the best of tropical grasses for pasture. This grass is of interest as being one of the earliest (1849) of plants in which Kew has been instrumental in distributing to the Colonies.

1. 1894, pp. 384-385.

Other Panicums of interest are "Little Millet" (*P. miliare*, Lam.), an annual 2 to 3 ft., cultivated in India for the seed as food and the plant for forage. "Shama Millet" (*P. colonum*, Linn.), grown for food and fodder in India. "Angola Grass" or "African Wonder Grass" (*P. spectabile*, Nees.), of Tropical Africa and America; a strong growing plant, 5 to 6 ft. high, suitable for moist situations (Barter describes it as an aquatic

grass, 6 ft. high, on the Niger), recommended as a fodder for cattle. "Blue Grass," "Colorado Grass" (*P. texanum*, Buckley), an annual plant 2 to 4 ft. high, valued for hay in Texas.

Digitaria exilis, *Stapf*; (*Paspalum exile*, Kipp.); "Fundi" (W. Africa), Hungry Rice (Sierra Leone).

Annual, $1\frac{1}{2}$ ft. high and upwards, native of West Africa, found in Sierra Leone, French Guinea, Nigeria, Togoland, &c.

Digitaria Iburua, *Stapf*; Iburua (Hausa).

Annual, $1\frac{1}{2}$ ft. high and upwards, native of Nigeria.

Both of the above are largely cultivated for the grain, used as food in the countries to which they are referred; they are remarkable for their minute grains—upwards of 50,000 to the ounce and are such that it is only in countries where labour is very cheap that they would find a place in the dietary.

1. 1915, "Iburu and Fundi, Two Cereals of Upper Guinea," pp. 381-386.

Setaria italica, *Beauv.*; Foxtail Millet, Italian Millet, Boer Manna, Hungarian Grass.

Annual, 2 to 4 ft. tropical and sub-tropical countries. In India and many other warm countries the grain is largely used for food and also in India for cage-birds and poultry. In Europe and America the plant is of greater importance as forage, especially for cattle. "Foxtail Millet" has long been regarded as unsatisfactory for horses unless fed sparingly (Piper), and this injurious effect upon horses is attributed to the seed if the hay is cut too late (Lyon & Hitchcock). Boer Manna is the staple hay crop in the Transvaal.

Pennisetum purpureum, *Schum.*; Elephant Grass, Napier's Fodder.

Perennial, 8 to 10 ft. high, native of Tropical Africa. Recommended as a fodder plant in Rhodesia, Cameroons, Uganda and other parts of Africa.

1. 1912, "Elephant Grass, A New Fodder Plant," pp. 309-316.

Pennisetum typhoideum, *Rich.*; Pearl Millet, Bulrush Millet, Gero (African), Cumboo or Spiked Millet, Bajra (India).

Annual, 3 to 6 ft. high. Tropical Asia and Africa. Introduced to the United States. The grain is largely cultivated in Africa and India, where in many parts it is the staple food of the natives, and in India the plant is sometimes cut green and also after the grain is ripe, for fodder. In the Southern United States it is grown as a forage crop, used more particularly as soilage, cut before the stems become hard and woody. The crop in the grain is usually subject to much loss by birds and might therefore be recommended for feeding poultry and game in this country. A sample of grain, with this view, was recently submitted to Kew for identification.

"Kikuyu Grass" (*P. longistylum*, Hochst.), of British East

Africa, has recently come under consideration at Kew as a fodder plant of promising value. "Arabjeb" (*P. ciliare*, Link.; syn. *P. cenchroides*, Rich.), is a good feeding grass in Somaliland, and in the same country *P. dichotomum*, Delile, is a good fodder for camels.

Euchlaena luxurians, *Miers.*) (*E. mexicana*, Schrad.); Teosinte, Buffalo Grass.

Annual, 6 to 8 ft., sometimes 15 ft. high, native of Mexico and Guatemala. A valuable fodder plant, widely distributed from Kew about 40 years ago to the East and West Indies, Australia and Tropical Africa. It is also cultivated in the Southern United States for fodder, used either as green feed or as ensilage.

1. 1894, "Teosinte," pp. 380-382.

Zea Mays, *Linn.*; Maize, Indian Corn, Corn.

Annual, 4 to 6 ft. high, including many varieties. Cultivated throughout the Tropics and Sub-tropics. The chief sources of supply of the grain to this country are Argentine (43516562), United States (7704816), Russia (1886192), Roumania (1122576), Canada (236880), British India (133168), British West Africa (200816), British South Africa (38864), Bulgaria, Turkey, Egypt, Morocco and Uruguay, the total imports amounting to 55,053,547 centals in 1913. The grain is a staple food wherever grown, and in the United States it is the chief source of alcohol. Maize corn is commonly used for feeding to stock, parrots, poultry and game. The cake made from the germs after expression of the oil is recommended as a good feed for animals, especially dairy cows. The plant is also grown for forage, cut and fed green, as ensilage or dried as hay. In England maize cannot be relied on to mature seed, but as a forage plant it is reported to do well in some parts of Cheshire, although as a rule it is not to be depended upon north of the Midlands (Journ. Bd. Agric. May, 1918, p. 233). The result of three years' experiments at the East Anglia Institute of Agriculture show that the American varieties "Improved Leaming," "Eureka," and "Wood's Northern Dent" are heavy yielders of green fodder (l.c. June, 1915, p. 265).

2. Dec. 1898, "Maize Products of the United States," pp. 392-395; March, 1902, "The Cultivation of Maize for Fodder," pp. 470-472; June, 1902, "Maize Growing Experiments," pp. 71-73; "Maize Ensilage," pp. 80-81 and "Maize Oil and Maize Oil Cake," p. 111; March, 1903, "Experiments in the Growth of Maize for Fodder," pp. 510-515; July, 1906, "Utilization of Green Maize for Fodder," pp. 229-230; April, 1907, "Maize as a Fodder and Silage Crop," pp. 14-22; Dec. 1907, "Feeding Pigs on Maize and Maize Meal," pp. 542-543; May, 1912, "Varieties of Maize for Forage Purposes," p. 136; May, 1918, "Growing Maize for Fodder," p. 233.

3. No. 73, 1908, "Cultivation of Maize for Fodder," No. 7, 1911, "Catch Crops and Fodder Supply," p. 4.

3a. No. 44, 1915, "Preserving Green Maize."

Zizania aquatica, *Linn.*; Canadian Wild Rice.

Aquatic annual, 9 to 12 ft. high, native of Eastern North America, where the seed or "wild rice" is an important food of the North American Indians. In Minnesota and other States it is a common food of wild duck and other wild-fowl. This grass is of interest as growing remarkably well at Kew and that special efforts have been made to acclimatise it in the United Kingdom; seed obtained from Canada being distributed to 23 estates in various parts of the Kingdom about 1909, the object being to augment the food supply of water-fowl. There is little evidence to show, however, that the seed will ripen properly in England. "Manchurian Water Rice" (*Z. latifolia*, Turcz.), an aquatic perennial, similar in habit to the foregoing, also grows well at Kew on the margins of the lake. It is a native of Manchuria, Corea, Japan, also occurring in China, where it is cultivated on flooded ground as a vegetable—the young shoots being used, called "Kiao Cabbage" or "Kiao Shoots."

1. 1900, "Indian Rice or Water Oats," p. 29; 1909, pp. 381-390.

Oryza sativa, *Linn.*; Rice.

Annual. Cultivated throughout the Tropics and in many sub-tropical countries under numerous varieties. The sources of supply are chiefly British India (2832299), Holland, Siam, Java, Straits Settlements, Spain (Alicante, Valencia, Castellon and Tarragona), Italy, Egypt, Japan, French Indo China, United States, Germany, Austria-Hungary, and Turkey, the total imports from all sources amounting to 4,801,130 centals (in 1913), including grain whole and cleaned and that in the husk. Known everywhere as a food. "Patna," "Rangoon," "Siam Garden," "Java," "Carolina," "Japan" and "Japanese Unpolished" are important commercial descriptions.

1. 1888, "The Cultivation of Rice in Bengal," pp. 284-291; 1892, "Black Burmese Rice," pp. 232-234; 1909, "Padi," pp. 277-279.

2. March, 1902, "Feeding Rice Meal to Pigs," pp. 518-519.

Melinis minutiflora, *Beauv.*; Brazilian Stink Grass, Honey Grass, Molasses Grass.

Perennial, 3 to 4 ft., native of Brazil and occurring in Tropical Africa, Madagascar, Ascension Island; introduced to Queensland, West Indies, Southern United States, &c. An excellent fodder plant valued in Brazil for horses and cattle; may be used green or as hay; but recommended to be cut before the seed-heads show.

1. 1900, "Brazilian Stink Grass," p. 31.

Saccharum officinarum, *Linn.*; Sugar Cane.

Perennial, 8 to 12 ft. high. Grown in all tropical countries; the chief producers, without reference to relative importance, being Cuba, British India, Java, Mauritius, Formosa, Philippine Islands, Queensland, New South Wales, Fiji, West Indies (English, French, and Danish), Guiana (English and Dutch),

Porto Rico, Hawaii, Central America, Mexico, Venezuela, Peru, Surinam, Brazil, Argentina, Louisiana, Egypt, Natal and Mozambique. Of these it will be sufficient to note that the three first-named are the only countries producing over a million tons (more than 22 million centals) each and that the United Kingdom relies more or less on all of them for supplies. In 1913, 8,279,242 centals of raw sugar were imported, of which Cuba contributed 5,022,692 (crop* harvested Dec.-June, 1912-13 was 54,399,229 centals), Java,† 2216 (crop harvested May-Nov., 1912-13—29,818,432 centals), and British India‡ 86,246 centals (crop harvested Dec.-May, 1912-13, 57,872,640 centals).

The sugar prepared from the juice of the cane is an important food throughout the world. The molasses (the liquid remaining after separation of the sugar crystals) is also used for food purposes, and mixed with other suitable substances—"Ground nut shells," see "Soga meal" (*Arachis hypogaea*), crushed "sugar-cane" ("Molascuit"), &c., it is a recognised cattle feed. In Mauritius and most of the sugar producing countries, during the harvesting season the tops of the cane are used for feeding both horses and cows.

A "Japanese Sugar Cane" or "Zwinga Sugar Cane," a variety with numerous slender stems, has been introduced to the Southern United States, grown for forage and extraction of syrup (Piper).

1. 1888, "Seedlings of Sugar Cane at Barbados," pp. 294-296; 1890, "The Sugar Production of the World," pp. 38-43; 1891, "Production of Seed and Seminal Variation in the Sugar-Cane," pp. 10-24 and "Production of Cane-Sugar in the Sugar-Cane," pp. 35-41; 1894, "Seminal Variation in the Sugar-Cane," pp. 84-86; "The Lahaina Sugar-Cane," pp. 418-419; "Improvement of Sugar-Cane by Chemical Selection of Seed-Canes," pp. 86-96; 1899, *ibid.*, pp. 45-46, "Sugar-Cane in the Sandwich Islands," pp. 201-203, 1897, "West Indian Sugar Trade," pp. 92-96, "Grafting Sugar Cane," pp. 221-223; 1912, "Sugar," pp. 168-169, pp. 179-180; 1914, "The Cultivation of the Sugar-Cane in Southern Spain," pp. 147-150.

2. June, 1898, "The Sugar Industry of Russia," pp. 69-71; June, 1901, "Molasses and Dairy Cows," pp. 45-47; Sept. 1903, "Exemption of Duty of Molasses used for Food for Stock," p. 260; May, 1911, "Molasses and Sugar Foods for Live Stock," pp. 97-106; March, 1916, "The Growing of Sugar," pp. 1210-1214.

Sorghum bicolor, *Moench*, var. **obovatum,** *Stapf.*

Annual, up to 14 ft. Cultivated in Angola, Mediterranean region, Madeira, India, Australia, West Indies and Brazil, more or less for the grain.

* For figures as to Crops, see "The International Sugar Journal, March, 1915, p. 149, and for those relating to Imports, Ann. St. Tr. U.K. i. 1917, as stated in introduction.

† The figures for Java are small in proportion to the imports for 1912 and 1914, which for those years averaged more than those given above for Cuba.

‡ The low import in proportion to the crop would indicate that the greater part is consumed locally.

Sorghum Caffrorum, *Beauv.*; Kafir Corn.
Annual, a variable plant up to 6 ft. high, including several races cultivated in Lower Guinea, South Africa, Mauritius and North America, for the grain and recommended for forage because of the sweet stems.

Sorghum caudatum, *Stapf.*
Annual, 14 ft., native of Tropical Africa, where it is commonly cultivated under several varieties for food; introduced to Tropical America and Jamaica. The variety "Feterita," common in Egypt and the Anglo-Egyptian Sudan, is an important food-grain, which, owing to its whiteness, has been recommended for making bread. An experiment with good quality wheat flour and 25 per cent. of "Feterita" flour was made at the Hygiene Bureau, Florence, and the resultant loaf described as well risen, light, uniform in colour, excellent in flavour and superior to that of other bread made from wheat, with the addition of rice, rye or potatoes (*see* Bull. Agric. Intell. Inter. Inst. Agric. Rome. July, 1915, pp. 983-984). This variety has been introduced to Arizona and other parts of the Southern United States as a forage crop.

Sorghum cernuum, *Host.*; Guinea Corn.
Annual, 10 ft. high and upwards, native of Upper Guinea. A staple food-grain in West Africa from Senegal to the Cameroons and in North Africa, and also grown in Egypt, India, Asia Minor, &c. Under the Bornu name of "Mazaggua" ("dry season corn") this is being experimented with in the West Indies, Rhodesia and other Colonies.

Sorghum Durra, *Stapf*; Durra.
Annual, 14 ft. and upwards, native of the Nile region. There are several varieties commonly cultivated in Egypt, Arabia, India, Afghanistan and the United States for the grain.

Sorghum guineense, *Stapf*; Dawa (Hausa), Guinea Corn.
Annual with tall stems, including three well-marked varieties, **tremulans**—grain white or reddish, **involutum**—grain white, **robustum**—grain reddish, and numerous cultural races, all natives of Upper Guinea, where the grain is a staple food. "Karandeffi" is a form under the var. *robustum*, the grain of which is said to give colic to animals, and the plant appears to be grown largely for dyeing Kano leather (specimens in Herb. Kew).

Sorghum halepense, *Pers.* (*Andropogon halepensis,* Brot.); Johnson Grass, Aleppo Grass, Evergreen Millet, Means Grass (S. Carolina), False Guinea Grass.
Perennial, 3 to 15 ft., native of Western Asia; found in India, Burma and Ceylon and the Mediterranean region; naturalized in the hotter parts of the United States. Seeds eaten by the poorer classes in India, where the plant is largely used for grazing and for hay; but it is regarded as injurious to animals if eaten too

young or stunted by drought (Watt). Cases of poisoning cattle have occurred in Montana and California; but no cases have been reported from the Southern States where the grass is most abundant, used both for pasture and as hay (Piper). In this respect, in common with other species of the genus, it evidently requires some care, especially when fed green. Where the plant finds a home, it spreads so readily that the difficulty seems to be not to grow it but to keep it under control.

1. 1914, "Poisoning by *Sorghum halepense*," pp. 229-230.

Sorghum Roxburghii, *Stapf*; Shallu (India).

Annual with stout, tall culms, including several varieties, cultivated in India, Africa and in the United States for the grain.

Sorghum saccharatum,* *Auct. vix Linn.*; Sugar Sorgo.

The Sugar Sorghums are annuals upwards of 10 ft. or so in height, containing in their stems sufficient juice from which sugar may be extracted on a commercial scale. Other Sorghums, it may be noted, contain a sweet juice, notably amongst the "Kafir" group (see *S. Caffrorum*), but not enough to justify their use for the extraction of sugar. The preparation of Sorghum sugar and syrup is of some importance in the United States, though as an industry it is small in comparison with that of "Sugar-Cane," and "Sugar Beet." Experiments were being made about 1880, and it is interesting to note that of the varieties grown at that time there are three—"Early Orange," "Early Amber" and "Honey Cane," in the collection presented by the United States Department of Agriculture to the Museum at Kew in 1882, that are enumerated by Piper with "Sumac," "Gooseneck" and "Planter" as being the principal Sorgos cultivated at the present time. The varieties belonging to this group may also all be grown for forage.

"Great Millet" or "Guinea Corn" may, with the exception of *S. halepense*, properly apply to all of the above species of *Sorghum*, as these names were always associated with *Andropogon Sorghum*, Brot. var. *vulgaris*, Hack. (*Sorghum vulgare*, Pers.), and Africa† is believed to be the home of most, if not all, of the cultivated plants that could be included under these names. Broadly, the cultivated Sorghums are sometimes divided into juicy and sweet-stemmed and dry-stemmed. They are grown chiefly for the grain, sugar and syrup from the stem, forage and for brooms. In Africa and Asia the grain for food is probably the most important element, and in the United

* This name is used here to apply to American Sugar Sorgo; but originally (Linn. Sp. Pl. ed. i) it was meant for *S. Roxburghii* or a form closely allied to it. In the second edition Linnaeus completely changed the diagnosis so as to fit it to a sweet stemmed form of the group of *S. bicolor*, Nees (*Andropogon bicolor*, Kunth; *Holcus bicolor*, Linn.). To this *S. saccharatum* of the second edition, some specimens received from Egypt as *S. saccharatum* appear to be referable; but whether they are identical with Piper's "Sorgo" I cannot say. *O. Stapf.*

† See the recent exposition of the genus Sorghum by Dr. Stapf in "The Flora of Tropical Africa," vol. ix., part i. (1917), pp. 104–154.

States, where also sugar and syrup is obtained (see *S. saccharatum*), the use for forage appears to come first. The grain in this country is better known as "Dari" or "Derry Corn," used for feeding poultry. The imports in 1913 amounted to 389,844 centals, chiefly from United States, Turkey in Asia, British India and Egypt. In other years substantial supplies have also come from Java, Persia, Japan, Cape of Good Hope, East Africa Protectorate and Natal. As forage the plants in countries which admit of full development may be used cut green, as hay, as ensilage or as pasture, and though the roughage at harvest time from all the varieties may have a secondary use as forage, the sweet-stemmed kinds (see *S. Caffrorum* and *S. saccharatum*) are usually preferred for this purpose. In England during the past few years experiments made in Essex go to show that Sorghum may prove a useful addition to the forage crops in the warmer parts. It is recommended to be cut green and fed in the same way as "Maize" (*Zea Mays*), valuable for dairy cows in late summer when the pastures begin to fail (Journ. Bd. Agric. *seq.*). Some uncertainty attaches to the genus as a fodder, and cases of poisoning have been recorded when pastured or used in a green state. There seems to be considerable difference of opinion as to the exact stage at which there is danger of poisoning: but it is generally conceded that the green plant is not safe for feeding until it is at or near the flowering period.*

1. 1897, "Sorghum Sugar," pp. 173-174.
2. May, 1915, "Sorghum," pp. 155-166.
3a. No. 53, 1916, "Sorghum for Fodder."

Sorghum sudanense, *Stapf* (*Andropogon Sorghum*, var. *sudanensis*, Piper); Sudan Grass.

Annual, with slender stems, 6 to 10 ft. high, native of the Sudan in the region of the Nile. Cultivated in Egypt and the United States for forage—suitable for hay and pasture and as a soiling crop—for which purpose it is better adapted than the Grain Sorghums. The plant suits dry regions better than "Johnson Grass" (see *S. halepense*), and comes to maturity quickly—about 3 months. The young plants are stated to withstand slight frosts without injury, the northern limit for maturity being estimated at about 49° (Piper), and it is suggested here that this would be the best sorghum with which to experiment in England. There appears to be no record available as to the poisonous effects of the young green plant on stock; but it would be advisable to exercise the same care as recommended above.

Amphilophis pertusa, *Stapf* (*Andropogon pertusus*, Willd.): Sour Grass.

Perennial, 1½ to 2 ft. Tropical Africa and found also in Arabia, Afghanistan, India and Ceylon; introduced to

* See "Cyanogenesis in Plants," part 2 "Great Millet" (*Sorghum vulgare*), Dunstan and Henry in Trans. Royal Soc. cxc. 1902, p. 399, and Proc. Roy. Soc. lxx. 1902, pp. 153-154, and "The Poisonous Properties of Immature Sorghum" in Bull. Imp. Inst. 1910, pp. 384–388.

Mauritius and Jamaica. An important fodder plant in the plains of Northern India, grown as pasture and for hay.

Other grasses that have been included under the term "Sour Grass" and referred to as *Andropogon pertusus* are **Amphilophis feracidulus,** *Stapf* (*Andropogon Ischaemum*, var. *americanus*, Hack.) of Antigua, Dominica and Montserrat; **Amphilophis intermedia,** *Stapf* (*Andropogon intermedia*, R.Br.) of Australia and **Amphilophis intermedia,** *Stapf* (?) var. **acidula,** *Stapf* (*Andropogon pertusus*, Stapf in *Kew Bull.* 1895, p. 209) of Barbados, Nevis and Guiana, and also known from the Gold Coast and Angola. They are all perennial plants and of some value as forage.

1. 1895 "Sour Grass (*Andropogon pertusus*)," pp. 209-210.

Phalaris bulbosa, *Linn.*; Toowoomba Canary Grass.

Perennial, 4 ft. high, native of the Mediterranean region, Portugal, Mesopotamia, &c., introduced to Australia and South Africa as a promising fodder plant.

1. 1909, "*Phalaris commutata*," pp. 79-80, and "Toowoomba Canary Grass," pp. 289-292.

Phalaris canariensis, *Linn.*; Canary Grass.

Annual, 2 to 4ft., native of Southern Europe; introduced to California, Argentine, Holland, &c. Imports of the seed into this country are chiefly from Turkey, Argentine, Spain, Portugal and Holland. In England the plant is recorded as being cultivated nearly a hundred years ago in the Isle of Thanet (Loudon, Encycl. Pl.) and Syme (Eng. Bot.) in 1872 refers to the "occasional cultivation in the southern counties, whilst town refuse has aided its spread in waste places and about gardens." Seed largely used for feeding birds, especially canaries.

"Reed Canary Grass" (*Phalaris arundinacea*, Linn.) a perennial 4 to 6 ft. high, native of the northern temperate regions; found near rivers and lakes and in ditches in Britain. It is recorded of this grass in Britain, "though the foliage is rather coarse it is relished by cattle and horses, and would probably answer well on wet land"; in the Northern United States, "furnishes an excellent quality of wild hay" (Hitchcock) and "the hay is palatable if cut young" (Piper).

Phalaris intermedia, *Bosc.* (*P. caroliniana*, Walt.), a perennial plant, cultivated to a limited extent in the Southern United States for winter forage (Hitchcock).

Anthoxanthum odoratum, *Linn.*; Sweet Scented Vernal Grass.

Perennial, 1 to 2 ft., native of Europe, Northern Asia, North Africa, &c.; wild and cultivated in Britain; introduced to North America. Grown in mixed pastures and for hay, which the fragrance due to the cumarin content is said to improve, though some difference of opinion seems to exist in reference to its value in this respect. Both Sutton and Hunter refer to the seed as being scarce and costly, and the latter mentions that an annual continental species (*A. Puelii*, Lecoq & Lamotte) a common weed and valueless for pastures is commonly sold for it.

Alopecurus pratensis, *Linn.*; Meadow Foxtail.

Perennial, 3 ft., of northern temperate regions; introduced to New Zealand. Common in meadows and pastures everywhere; grown largely in permanent pastures and for hay, especially in Northern Europe. Commercial supplies of seed for cultivation in Britain come chiefly from Holland, Sweden, Southern Russia, Finland, &c.

2. June 1909, "Meadow Foxtail," pp. 193-198.

Phleum pratense, *Linn.*; Timothy Grass, Meadow Catstail.

Perennial, 1 to 3 ft., native of Europe and northern temperate regions. Although a European grass its value under cultivation was first realised in America, from whence it was introduced to England by Timothy Hansen (hence the popular name) about 1780 (Loudon). It is a most important hay and pasture plant in Britain and in America—the area here exceeding all other perennial grasses in the "blue grass" region (see p. 30, under *Poa pratensis*). Commercial seed is grown in America, including Canada and on the Continent.

Agrostis alba, *Linn.*; Redtop, Fiorin, Bent Grass, Fine Top Grass.

Perennial 1 to 4 ft. Temperate regions, where, in Europe, America, &c., it is one of the standard crops for permanent pastures and for hay. The var. **stolonifera,** is also known as "Fiorin" and "Creeping Bent Grass," also commonly grown in pastures.

Trisetum flavescens, *Beauv.* (*Avena flavescens*, Linn.): Yellow Oat Grass, Golden Oat Grass.

Perennial 1 to 2 ft. Europe, Asia and North Africa, and to some extent in America, grown for hay and in mixed pastures.

Avena sativa, *Linn.*; Oat.

Annual. Cultivated in many varieties. Imports of the grain are chiefly from Argentina (7169904), Germany (3832976), Russia (3118976), Canada (2629760), United States (1606096), Chile (924672), Roumania (682640), New Zealand (108976), Netherlands (105392), Turkey in Asia (43904), Turkey in Europe (2240), Australia (7952), and British South Africa (but no returns 1913). The production in the United Kingdom for the same year (1913) amounted to 62,807,248 centals or more than three times the amount imported. An important food as oatmeal and "rolled oats" and fodder—crushed grain and straw for horses, and the plant before maturity is sometimes cut for forage. "Sussex Ground Oats" are specially recommended for rearing and fattening poultry.

2. June 1898, "The Oats Supply of the United Kingdom," pp. 25-28; June, 1903, "Experiments in the Growth of Oats," pp. 53-56; July, 1904, "Effect of bad weather on the Vitality of Oats," pp. 217-219; July, 1905, "Experiments with Varieties of Oats," pp. 219-221; Oct., 1906, "Sussex Ground Oats," pp.

429-431; August, 1907, "The Milling Properties of Oats," pp. 257-268; Dec., 1914, "Substitutes for Oats in Feeding Farm Horses," pp. 808-811; May, 1915, "The Identification of the Country of Origin of Commercial Samples of Oats," pp. 165-166; May, 1916, *ibid.*, pp. 105-116, and tables i.-iii.; Feb., 1917, "Varieties of Oats and Barley," pp. 1056-1063; June, 1916, "Silage made from Oats and Tares as a Food for Milking Cows," pp. 224-229.

3a. No. 19, 1914, "Substitutes for Oats in Feeding Farm Horses." No. 36, 1915, "Winter Oats."

Arrhenatherum avenaceum, *Beauv.* (*Avena elatius*, Beauv.); Tall Oat Grass, Tall Meadow Oat Grass, False Oat Grass, French Rye Grass.

Perennial, 2 to 4 ft. Europe; cultivated in Sweden, France, Switzerland, and Britain; also in the United States and Australia for hay and mixed pastures.

Cynodon Dactylon, *Pers.;* Bermuda Grass, Bahama Grass, Wire Grass (Virginia), Indian Couch, Doub, Dog's-tooth Grass.

Perennial, usually low-growing, 4 to 6 in., but sometimes up to 3 ft. (this height being given on a specimen from Somaliland in Herb. Kew). Cosmopolitan in hot countries and found in some temperate regions, including parts of the south of England. Grown in the West Indies, India, United States, Australia, &c., for pasture and for hay. In the West Indies the underground rhizomes are also used for feeding animals. In the United States it is stated to be "the most important perennial grass in the South, filling much the same position in respect to pasturage as 'Kentucky Blue Grass' (see *Poa pratensis*) in the North." Recommended in combination with *Lespedeza* (see p. 8); "good Bermuda pastures will carry one cow to the acre, and the best Bermuda and Lespedeza mixed pastures will support two cattle to the acre during the summer," and "compared with Timothy (see p. 28) as a hay feed for work mules of equal value" (Piper). On specimens in the Herbarium at Kew this grass is noted as being used for feeding stock in British East Africa, Somaliland, Rhodesia, Unyoro and Mossamedes.

1. 1894, pp. 377-378.

Chloris Gayana, *Kunth*; Rhodes Grass.

Perennial, native of Tropical Africa; introduced to Australia, Montserrat, Porto Rico, the Southern United States, &c. A useful fodder plant for stock. Grown as a meadow grass in the Southern United States (Hitchcock).

Chloris tenella, Roxb., is mentioned as good fodder in India (Watt) and in Somaliland (Appleton, Herb. Kew).

Eleusine coracana, *Gaertn.*; Ragi (India), Ginger Millet, Tamba (N. Nigeria).

Annual, 2 to 5 ft.; cultivated in India and Africa as a cereal, a particular feature of which appears to be the cheapness of the grain, and although a staple food in some parts, it is sometimes

only regarded as a famine food. In India the straw is used for fodder, and Lunt on a specimen in the Kew Herbarium notes that it is cultivated in the Hadramaut (vernac. "Dokhn") as "food for cattle."

Cynosurus cristatus, *Linn.*; Crested Dog's-tail Grass.
Perennial, 1 to 2 ft. Europe; commonly cultivated in meadows and pastures, especially valuable in sheep-runs (see also "Hard Fescue," p. 31, and "Sheep's Fescue," p. 31). Sutton recommends it for Deer Parks.

Eragrostis abyssinica, *Schrad.*; Teff, Theff or Thaff (Abyssinia).
Annual, 2 to 4 ft., native of Abyssinia; distributed from Kew to various British Possessions in 1886 (seed obtained from Abyssinia), including India, Australia, Natal, British Guiana, and later also to California and the Transvaal. Everywhere it seems to have met with conspicuous success as a valuable hay and pasture grass, suitable for all kinds of stock. The seed is used in the country of origin for making bread.
1. Jan. 1887, "Teff," pp. 2-6; 1894, pp. 378-380; 1913, pp. 32-39.

Dactylis glomerata, *Linn.*; Cock's-foot Grass, Rough Cock's-foot Grass, Orchard Grass.
Perennial, 2 to 3 ft., native of Europe and widely distributed in temperate regions, extending to New Zealand, where it has become the commonest grazing grass. Cultivated in all countries in pastures and for hay; but for this purpose recommended to be cut early as the stems at maturity get hard and woody.

Poa nemoralis, *Linn.*; Hudson's Bay or Evergreen Meadow Grass, Wood Meadow Grass.
Perennial, 1 to 2 ft., of the temperate regions of Europe and Asia and in North America. A well-known pasture grass often used also for lawns in shady places. Sutton states that "the seed is too costly and the supply too uncertain to warrant a large use of it in ordinary grass land." Commercial seed has been largely collected from wild plants in Germany.

Poa pratensis, *Linn.*; Smooth-stalked Meadow Grass, Kentucky Blue Grass, Blue Grass, June Grass.
Perennial, 1 to 2 ft., of the northern temperate regions; introduced to New Zealand. Cultivated in Europe, North America, &c., for pasture, suitable for all kinds of stock. In America it is "second among grasses in total value only to "Timothy" (see *Phleum pratense*) in the region of which "all the best pastures are wholly or primarily Blue Grass" (Piper).

Poa trivialis, *Linn.*; Rough-stalked Meadow Grass.
Perennial, 1 to 2 ft., of the northern temperate regions; meadows and pastures of the mountainous districts of Europe, with a good rainfall. Of lesser importance in America than the foregoing.

The genus is an important one for meadow grass and as of secondary importance to the above may be mentioned "Canada," "Virginia," or "Flatstone" Blue Grass (*Poa compressa*, Linn.), native of Northern Europe; "Texas Blue Grass" (*Poa arachnifera*, Torr.), native of North America; "Fowl Meadow Grass" (*P. serotina*, Ehrh.), of the northern temperate regions and "Tussock Grass" (*P. flabellata*, Hook., *Dactylis caespitosa*, Forst.), a native of the Falkland Islands, introduced to Britain in 1842 as a fodder plant with success only in the West of Scotland.

Glyceria aquatica, *Wahlenb.* (*Poa aquatica*, Linn.); Water Meadow or Sweet Reed Grass.

Perennial, upwards of 6 ft. high, growing in low-lying and sometimes flooded ground in the northern temperate regions. Common in the Fen districts of Cambridgeshire and Lincolnshire where it is an important fodder plant, cut green in summer and as hay for winter.

"Floating Sweet Grass" (*Glyceria fluitans*, Br.), a semi-aquatic perennial, common in Britain and on the Continent. The grain is used as food in Germany, Holland, Poland and Russia.

Festuca arundinacea, *Schreb.* (*F. elatior*, Linn. sub-sp. *arundinacea*, Hack.); Tall Fescue.

Perennial, 3 to 6 ft. (Sutton), 3 to 5 ft. (Armstrong). Europe, North Africa, grown for hay and pasture. Seed for England was chiefly produced in the Rhenish Provinces, and it is now practically unobtainable (Hunter). Sutton distinguishes the continental plant as *F. elatior*, var. *fertilis*, Sinclair, the English grown seed not being considered reliable for fertility.

"Reed Fescue" (*F. littoralis*, Br.), a native of New Zealand, is sometimes sold for "Tall Fescue," but it is not recommended on account of its coarse, reedy nature (Hunter, Armstrong).

Festuca duriuscula, *Linn.* (*F. ovina*, Linn. var. *duriuscula*, Koch.); Hard Fescue.

Perennial, 1 ft. and upwards. Europe; commonly in hilly districts, of importance in sheep pastures, and for permanent grass lands.

Festuca heterophylla, *Lam.* (*F. rubra*, Linn. sub-sp. *heterophylla*, Hack.); Various-leaved Fescue.

Perennial, 3 ft. Europe; cultivated in Britain for permanent pastures.

Festuca ovina, *Linn.*; Sheep's Fescue.

Perennial, 6 ins. or so in height. Europe; common in pastures, especially for sheep; N. Europe—Russia, Highlands of Scotland, &c., and in Siberia. A var. *tenuifolia* is known as "Fine-leaved Fescue."

Festuca pratensis, *Huds.* (*F. elatior*, Linn. sub-sp. *pratensis*, Hack.); Meadow Fescue.

Perennial, 1½ to 3 ft. Europe and N. Asia; recommended in Britain for hay and permanent pastures. Commercial seed is imported from Denmark and the United States (Hunter). "Meadow Fescue" is "of small importance in American agriculture, except in Eastern Kansas, where much seed is grown principally for export to Europe" (Piper).

Festuca rubra, *Linn.*; Red Fescue, Creeping Fescue.

Perennial, 1 to 2 ft. Northern temperate and arctic regions, New Zealand, &c. In Europe grown in meadows and pastures and recommended where hares are preserved. In North America, though wild, it does not appear to be much cultivated for forage. Both Sutton and Hunter indicate difficulty in obtaining seeds of this grass, and the latter recommends a variety called "Chewing's Fescue" from New Zealand. Armstrong (*seq.* p. 151) identifies this variety with *F. rubra*, var. *fallax*, Hack. [*F. fallax*, Thuill., found in all Europe except Russia and the Balkans], and mentions that it is not "of much agricultural value in Britain"; but Piper (*seq.* p. 227) states that for all practical purposes "Chewing's Fescue" is identical with the European Red Fescue.

Bromus inermis, *Leyss.*; Brome Grass, Awnless Brome Grass, Hungarian Forage Grass.

Perennial, 1 to 3 ft., native of North Europe, Caucasus region, Siberia, and found in the Western Himalaya. An important fodder grass in Germany and Hungary; grown also in Britain and North America; suitable for all kinds of stock.

Bromus unioloides, *H. B. & K.* (*B. Schraderi*, Kunth); Fescue Grass, Schrader's Brome Grass, Australian Brome.

Annual or biennial, 2 to 4 ft. high, native of South America Argentine, cultivated in the Southern United States for winter forage (Hitchcock), and Australia, where practically all the commercial seed is grown (Piper), and to a small extent in England.

"Chess or Cheat" (*Bromus secalinus*, Linn.), native of Europe, Mediterranean region, N. Asia, &c., a common weed in wheat fields, is cultivated for hay in Oregon and Washington (Hitchcock), in North Georgia under the name of "Arctic Grass." "produces good crops of hay which liverymen consider equal to "Timothy," especially if it be cut while the seeds are in the dough stage" (*idem*).

"Erect, Upright or Meadow Brome" (*B. erectus*, Huds.), is a perennial species, 3 ft. high, native of Temperate Europe and Asia and found in Algeria; cultivated in Southern France for forage.

Lolium perenne, *Linn.*; Perennial Rye Grass, Red Darnel.

Perennial, 1 to 2 ft. Europe, Temperate Asia and North Africa; cultivated in New Zealand. One of the oldest and best known grasses for permanent pastures and rotation in Europe. Commercial supplies of seed grown largely in Scotland and Ireland.

2. May, 1904, "Use of Rye Grass in Seed Mixtures," pp. 105-106; Oct. 1904, "Perennial and Italian Rye Grass," pp. 418-419.

Lolium multiflorum, *Lam.* (*L. italicum*, A. Br.); Italian Rye Grass.

Annual or biennial, 2 to 4 ft. Europe, and also cultivated in New Zealand, Argentine, &c. Recommended as a pasture grass and for hay in alternate husbandry; and has been found very successful grown alone under irrigation in connection with sewage farms. Commercial seed grown in the countries above-mentioned and also produced in the North of Ireland.

2. April, 1915, "Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs," p. 25.

3a. No. 28, 1916, *ibid.*, p. 3.

Secale cereale, *Linn.*; Rye.

Annual. Cultivated under several varieties in Northern Europe, Central Europe and N. America, the imports coming chiefly from Russia (493954), United States (234651), Canada (192987), Germany (77067), Roumania (15680), and cultivated also in France and England as a green fodder crop and for the grain used like wheat for making bread, though for this purpose in England it is not so much in favour because of the dark colour of the flour. The grain is amongst other grasses the commonest matrix of "Ergot" (*Claviceps purpurea*, Tul.) and in countries where rye bread is a staple food, the people are subject to "Ergotism," a disease which ultimately paralyses the lower limbs.*

2. March, 1909, "Production of Hand Thrashed Rye Straw in France," pp. 926-927; Oct., 1917, "Grain Crop," pp. 731-733.

3a. No. 28, 1916, "Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs," p. 3.

Triticum sativum, *Lam.*; Common Wheat.

Annual. Cultivated in many varieties, including "Flint Wheats" (*T. durum*, Desf.), "Rivet Wheats" (*T. turgidum*, Linn.), &c. Grain imported chiefly from the United States (38156097), Canada (24402448), British India (21018032), Argentine (16526944), Australia (11341857), Russia (5612432), Chile (856912), Germany (501312), New Zealand (62944), Roumania (43232), Turkey in Europe (39984), Turkey in Asia (5936), Persia (11200), Netherlands (1792), Belgium, Bulgaria and Uruguay (no imports in 1913 from the last three countries). The United Kingdom produced in the same year (1913) approximately 34,017,840 centals.

The entire dependence on this familiar cereal for bread and the use of the milling residue as bran, &c., for feeding stock, gives it first place as a foodstuff in the Order, and it is, perhaps, equalled only by rice in the whole series under review. The Flint varieties are largely used in Southern Europe, Italy especially, for making Vermicelli, Macaroni and Semolina.

* See "Plants Poisonous to Live Stock," H. B. Long (1917), pp. 88–91, for particulars of this poisonous fungus.

Hordeum vulgare, *Linn.*; Barley.

Annual. Cultivated in many varieties; grain imported chiefly from Russia (6837600), United States (4970672), British India (4053728), Canada (2869216), Turkey in Asia (2500176), Turkey in Europe (5376), Roumania (1555456), Denmark (582512), Germany (399392), Tunis (390544), Argentine (296464), Austria Hungary (298816), Algeria (138768), Chile (93184), France (45920), Cyprus (29568), Persia (28784), Belgium (4368), Australia (3248), Mexico (2352), and Morocco, the United Kingdom producing in the same year (1913) 32,816,264 centals.

The varieties of four-rowed, also known as "Bere" or "Bigg," are sometimes grown for green forage, but the grain is principally used for making beer and whiskey, the dried grains from the breweries and distilleries being used for feeding stock and for the same purpose the "malt culms" (the rootlets and shoots developed when germinating the grain for conversion into malt) are also used. The prepared grain as "Pot" and "Pearl" barleys is well-known as food.

Arundinaria Maling, *Gamble;* Maling Bamboo.

Culms upwards of 15 ft., native of Sikkim; commonly cut as forage for ponies in the neighbourhood of Darjeeling.

Bambusa arundinacea, *Willd.*; the Spiny Bamboo.

A tall, graceful grass, 80 to 100 ft. high, wild and cultivated in India and Burma. "The seeds, which somewhat resemble wheat, are edible, and have in certain years proved of great value in supplementing food supplies, more especially since flowering very frequently accompanies seasons of famine or scarcity"; "the young shoots are eaten and somewhat resemble asparagus; the leaves are very largely employed as fodder, more especially for buffaloes and elephants" (Watt).

Melocanna bambusoides, *Trin.*; Terai Bamboo, Berry-bearing Bamboo.

A tall, strong grass, 50 to 70 ft. high, of Eastern Bengal and Burma. It is remarkable for its large edible fruit, which occasionally germinates before separating from the stem.

The "Male Bamboo" (*Dendrocalamus strictus,* Nees) with culms 20 to 100 ft. high, common throughout India and Burma, yields a food grain, and many more Bamboos might be mentioned as useful for fodder or food; but the young shoots of probably all are eaten more or less for food in India and on the rare occasions when the plants do flower and fruit, the grain of many species appears to be of value.

1. 1889. "Food Grains of India—*Dendrocalamus strictus,*" pp. 283-284; 1907, "The Flowering of Cultivated Bamboos," pp. 228-233; 1912, "The Arundinarias of the Hills of Sikkim," pp. 135-140.

The imports of Grass seeds probably all for use in Agriculture are given under "Clover and Grass" Seed, and the two are entered here for convenience (see *Trifolium*, p. 6). The total imported in 1913 amounted approximately to 264,799 centals,

chiefly from France, United States, Germany, Denmark, Chile, Argentine, Russia, Holland, Belgium, Italy, Austria-Hungary.

The production from 6,770,173 acres in England and Wales in the same year was for "Hay from Clover, Sainfoin and Grasses under rotation," 60,683,123 centals, and for "Hay from Permanent Grass" or "Meadow Hay," 142,088,889.

Many more grasses of value, though more or less only of local importance, and often only substitutes for better plants, might be enumerated. To mention one or two examples of this kind we have "Rice Grass," "Sea Rice," or "Sedge" (*Spartina alterniflora*, Loisel), a grass used primarily for mud-binding; but which is cut regularly for fodder in the neighbourhood of Southampton (see K.B. 1907, p. 194); "Marram Grass" (*Ammophila arundinacea*, Host.), a sand-binding plant common on the sandy shores of Britain, introduced to Victoria in 1883, originally for sand-binding; but which has since been found of value also for fodder in the localities where it has been established (1. c. 1897, pp. 211-217; 1913, p. 364) and "Spire Reed" or "Common Reed" (*Phragmites communis*, Trin.), common in marsh-lands in Britain, the young tops of which have been recommended for feeding stock in hard times (see Sp. Leaflet, No. 34, 1915, "Autumn & Winter Fodder," pp. 2-3). But, for these and for further information on those already mentioned, the following works may be referred to:—

Kew Bulletin.—"Tropical Fodder Grasses," 1894, pp. 373-387; 1895, pp. 209-211; 1896, pp. 115-118. "The Grasses of British Somaliland," 1907, pp. 203-228. "Australian Grasses," 1908, pp. 21-29. "Economic Notes on Transvaal Grasses," 1911, pp. 158-161.

"A List of the Grasses of North Western India: Indigenous and Cultivated," J. F. Duthie, pp. 1-47 (Roorkee 1883).

"Illustrations of the Indigenous Fodder Grasses of the Plains of North Western India," *idem*, Part i., Plates i.-xl. (Roorkee, 1886), Part ii., Plates xli.-lxxx. (Roorkee, 1887).

"A Census of the Grasses of New South Wales," F. Turner. pp. 1-57 (Govt. Printer, Sydney, 1890).

"Australian Grasses," *idem*, vol. i., pp. i.-xxxviii and 1-58 (Govt. Printer, Sydney, 1895).

"The True Grasses," E. Hackel; translated from "Die Natürlichen Pflanzenfamilien," by F. Lamson-Scribner & E. A. Southworth, pp. 1-228 (Constable & Co., Westminster, 1896).

"Economic Grasses," F. Lamson-Scribner, U.S. Dept. of Agric. Div. of Agrostology, Bull. No. 14, 1898, pp. 1-85.

"A Manual of the Grasses of New South Wales," J. H. Maiden, pp. 1-199, illustrated, with notes of "Value as Fodder" (Govt. Printer, Sydney, 1898).

"The Chief Species, Races, and Varieties of European Cereals," J. Percival, pp. 1-12, illustrated by 28 sheets of dried specimens (Headley Bros., Kent and London, 1902).

"Literature on the Races of Rice in India," Agricultural Ledger, No. 1, 1910, pp. 1-334; Second half, pp. 335-594 (Calcutta, 1910 & 1911).

"The Corn Crops: A Discussion of Maize, Kafirs, and Sorghums as grown in the United States and Canada," E. G.

Montgomery, pp. 1-347, illustrated (The Macmillan Company, New York, 1913).

"Native Pasture Grasses of the United States," D. Griffiths, L. Bidwell & C. E. Goodrich, U.S. Dept. of Agric. Bull. No. 201, 1915, pp. 1-52, Plates i.-ix.

"A Textbook of Grasses: With Especial Reference to the Economic Species of the United States," A. S. Hitchcock, pp. 1-276, illustrated (The Macmillan Company, New York, 1914).

"The Small Grains," M. A. Carleton, pp. 1-699, illustrated (The Macmillan Company, New York, 1916)—all Grasses excepting "Buckwheat" (*Fagopyrum esculentum*, Moench) included in chapter xxii., pp. 581-599.

"British Grasses and Their Employment in Agriculture," S. F. Armstrong, pp. 1-199, illustrated (Cambridge University Press, 1917).

CRUCIFERAE.

Brassica campestris, *Linn.*, var. **chinensis.** Chinese Cabbage, Shantung Cabbage, Peh-tsai (China).

Annual. China, India—a garden crop. A correspondent of "The Garden" (Nov. 18, 1893) who had grown this cabbage in England, regarded it as worthless boiled as a vegetable, but of great value and excellent as a late autumn salad—"white, crisp, and sharp as the best summer cos lettuce." In China the Shantung cabbage is grown everywhere but attains its greatest perfection in the colder parts; it is the favourite variety amongst the half dozen other varieties cultivated, eaten fresh or preserved by salting and drying in the sun; the Chinese prefer their own varieties to the common European cabbage also widely cultivated there; but the same author considers that "from a European standpoint no variety of Chinese Cabbage is worth growing being so very inferior in flavour to our own."—(Wilson, "A Naturalist in W. China," ii. (1913) p. 56).

The Shantung Cabbage was grown at Kew in 1888 from seed sent by the Commissioner of Customs at Chefoo and seeds ripened at Kew were distributed to correspondents interested in new vegetables. Enquiries recently made show that interest in the plant seems to be reviving.

1. 1888, pp. 137-138; 1893, p. 344.

Brassica campestris, *Linn.* var. **oleifera**; European Colza.

Annual or biennial, 2 to 3 ft. high. Europe—France, Belgium, &c. (see European Rape for imports to United Kingdom). Cultivated for seed and green fodder. "A Pirou (Manche) le 16 Mai, 1833, généralement cultivé dans le pays comme plante oleifere ce font les graines qui fournissent l'huile" is an interesting statement on an old specimen in the Kew Herbarium. "Colza has been grown to some extent in Essex and Lincolnshire, but is less in favour with English farmers than the rape, though producing more seed" (Johnson & Sowerby). Most of the Economic literature on this plant appears to be more or less involved with that of "Rape" (*B. Napus*, Linn., var. *oleifera*) (q. v.) and indeed for general purposes it may be regarded as the same.

Brassica campestris, *Linn.* var. **Sarson**; Indian Colza, Sarson (India).

Annual, 4 to 5 ft. high. India—a cold season crop. Oil from the seed used in India for cooking. See "Indian Rape" for imports of seed.

I. 1894, pp. 96-97. "Guzerat Rape" (*B. campestris*, var. *glauca*).

Brassica juncea, *Hook. f. & Thoms.* (*B. Besseriana*, Andrez.) Indian Mustard, Rai (India).

Annual, 3 to 6 ft. (Prain) 2½ to 10 ft. (Rep. Agric. Res. Inst. Pusa, 1914-15, p. 41). India—a field crop, but on a smaller scale than "Rape" (Watt); cultivated in Sarepta, Astrakhan—Volga River, and other parts of Southern Russia, Abyssinia, Angola (Fl. Trop. Afr.). Oil from the seed used for food in India and Russia, the green plant for cattle fodder and young leaves as a vegetable in India. It is probable that this mustard is used with that of *B. alba* and *B. nigra* in preparations for table use.

Brassica Napus, *Linn.* var. **dichotoma**; Indian Rape, Tori (India), Summer Rape (Europe).

Annual, 1 to 4 ft. India (395287)—a field crop on the plains in the cold season, on the Himalayas in the spring (Watt); Europe—a summer crop. Oil from the seed used as food and green plant for cattle fodder in India. Oil in this country classed with "Colza"—chief use for burning and lubricating, but sometimes when refined for food; cake an important cattle feed. It would seem that the seeds of this plant are often crushed with those of *B. juncea*, the Indian Mustard. Some samples of cake were recently submitted to Kew and found to contain seed coats of both plants; the cake was strongly suspected of having been the death of a number of cows, the cause obviously being due to the high percentage of mustard seed residue in it—similar trouble is referred to in Kew Bulletin, 1894, p. 96, at which time it was stated the matter had often been investigated at Kew, and the advice given that "Rape cake used for feeding should be free from any seed containing Mustard oil." It is, moreover, difficult if not impossible to separate the trade particulars of "Rape," "Mustard," and "Colza" seed from India, and the figures given must therefore refer more or less to all three. The seed goes under the names of "Brown Cawnpore," "Yellow Cawnpore," "Yellow Guzerat," "Ferozepore," "Jamba" (see *Eruca sativa*), &c., and the oil as "Brown East Indian," "Jamba," &c. A sample of so-called "Bombay Brown Mustard" seed submitted to Kew for identification was found on cultivation to belong to the variety under consideration, and samples of this and of *B. juncea* have been received under the description of "Mustard seed from India."

Brassica Napus, *Linn.* var. **oleifera**; European Rape.

Annual or biennial, 2 to 4 ft. Russia (489048 seed), Germany (14406 seed, 34473 oil), Netherlands (7845 seed, 20227 oil), Belgium (8992 seed, 42201 oil), France (8198 oil), Great Britain,

Canada, United States—cooler parts. Rape seed is well-known for feeding cage-birds and poultry. Oil expressed from the seed when refined used as food, but its chief use usually under the name "Colza" is for burning and lubricating; cake used for feeding cattle. In the last three mentioned countries the green plant is grown chiefly for forage, as a soiling crop for steers or young stock, the pasturing of hogs and sheep, and also recommended for ensilage. Rape, amongst other plants, is advised in Bd. of Agric. Special Leaflet, No. 30, 1915, for pig-feeding, both as a pasturing and soiling crop. The variety grown for forage is chiefly "Dwarf Essex," and in all probability the names "Broad-leaved Dwarf Essex," Broad-leaf Winter Rape," "Giant," &c., are synonymous.

2. May, 1917, "Rape Pastures," pp. 182-187.

3a. No. 28, 1916, "Rape," p. 4; "Rye and Rape mixed," p. 5.

Brassica alba, *Hook. f. & Thoms.*, White Mustard. **B. nigra,** *Koch.*; Black or Brown Mustard. European Mustard, Grocer's Mustard.

Annuals, 1 to 4 ft. France—Alsace (Vilmorin) and Southern Europe, Germany, Holland, Asia Minor, Abyssinia (Fl. Trop. Afr.); England—Eastern Counties near the Fens and bordering the Wash, more particularly "Black"; the "White is grown chiefly in Essex and Cambridge. The powdered seeds of the two species are used in the preparation of table mustard, usually husked before grinding in England, ground whole in France, the flour made from the whole seed being the more pungent of the two. "Charlock" (*Brassica Sinapistrum*, Boiss.) seeds are sometimes used as a substitute for those of the true mustard, and possibly also those of *B. juncea*. The following decision of the Board of Food and Drug Inspection of the United States Dept. of Agriculture in reference to this form of adulteration was noted in the Board of Trade Journal, Oct. 12, 1911:—"It is the opinion of the Board that when charlock is substituted in part for mustard the label should clearly indicate this fact. A condiment prepared from mustard or mustard flour and charlock with salt, spices and vinegar is not "Prepared Mustard,' but, provided a greater quantity of mustard than of charlock is used, it should be called 'Prepared Mustard and Charlock.'"

The White Mustard is commonly grown for salad and as green fodder for sheep.

2. Dec. 1896, "Cultivation of Mustard in England," p. 301. Feb. 1916, "The Growing of Mustard Seed," pp. 1134-1136.

3a. No. 28, 1916, "White Mustard" p. 4; No. 58, 1916, "White Mustard."

Brassica rugosa, *Prain*; Cabbage Mustard, Chinese Cabbage Mustard, Chinese Cabbage-leaved Mustard.

Annual, 4 to 6 ft. China, India—a cold weather crop in West, Central and East Himalaya (Watt). Cultivated as a vegetable and for the sake of the oil obtained from the seeds.

Eruca sativa, *Linn.*; "Brassica Substitute," Rocket, Jamba (India).

Annual, 6 in. to 1½ ft., S. Europe, N. Africa, Hadramaut (Arabia), India (*see* imports under "European Rape"—exported from Karachi under the name of "Jamba," commonly grown with barley, gram, peas or cotton as a substitute for "Sarson" or "Rape"; oil from the seed used for food, but mainly as an illuminant, cake for feeding cattle and green plant for fodder (Watt). Young leaves eaten as salad in France (Vilmorin); cultivated at Katan, Hadramaut, where the roots are used as salad (Kew Bull. 1894, p. 328).

Camelina sativa, *Crantz.*; Yellow Dodder, False Flax, Gold of Pleasure.

Annual, 2 to 3 ft. high. A common weed in this country, the United States, Canada, &c.; cultivated to a limited extent in Southern Russia. Oil from the seed used in Central Europe for a variety of domestic purposes. Cake as a feeding stuff for cattle uncertain; plant sometimes grown as green fodder for sheep; seeds liked by birds, especially finch and bunting; poultry and geese particularly are very fond of the seeds and fatten quickly upon them (Johnson & Sowerby). An analysis of "Gold of Pleasure Cake (Camelina)" shows water 10·25, oil 11·2, albuminoids 35·37, digestible carbohydrates 25·64, woody fibre 11·53, mineral matters 6·01, sand and silica 0·8 (Smetham).

Cochlearia Armoracia, *Linn.*; Horse Radish.

Perennial. Belgium, Holland, Germany, Great Britain—a garden crop, the trade relying on supplies from the aforementioned countries. Nearly half a century ago it was recorded ("The Garden," Dec. 16, 1876, p. 576) that "It is somewhat remarkable that a crop so easily grown as Horse Radish should be sufficiently remunerative to pay for importation whilst in the London market-gardens comparatively little of it is grown," and enquiries made by Kew at Covent Garden recently show that similar conditions prevail in this country to-day, when the cultivation might still more be worthy of some extension.

2. March, 1890, "Cultivation of Horse Radish in Bohemia," pp. 493-494.

Other plants in Cruciferae that may be noted are the well-known "Cabbage" (*Brassica oleracea*, Linn. var. *capitata*), "Kale" or "Borecole" (*B. o.* var. *acephala*), "Savoy" and "Brussels Sprout" (*B. o.* var. *bullata*), "Cauliflower" and "Broccoli" (*B. o.* var. *Botrytis*), "Kohl-rabi," "Siam Cabbage" or "Hungarian Turnip" (*B. o.* var. *caulo-rapa*), "Turnip" (*B. campestris*, Linn. var. *esculenta*), "Swede Turnip" (*B. c.* var. *napo-brassicata*), "Cress" (*Lepidium sativum*, Linn.), "Water Cress" (*Nasturtium officinale*, R. Br.), "Sea Kale," (*Crambe maritima*, Linn.), all grown on a field or market-garden scale.

Journal of the Board of Agriculture:—"Storing Turnips," Oct. 1904, pp. 398-401; "The Value of the Turnip as a Vegetable and Stock Food," April, 1916, pp. 66-67. "The Cultivation of Water Cress," Feb. 1909, pp. 826-834; March, 1915,

pp. 1093-1098. "Experiments as to the Quality of Swedes," Aug. 1906, pp. 282-288. "Cultivation of Sea Kale," March, 1914, pp. 1088-1090. Board of Agriculture Leaflet, No. 153, 1905, "Storing Turnips."

"Water Cress: Its History and Cultivation." W. W. Glenny in Journ. Roy. Agric. Soc. viii. (1897), pp. 607-622.

"Mustard: A note on the Mustards Cultivated in Bengal," D. Prain, Bull. No. 4, 1898 (Reprinted from Agric. Series, No. 3, Dept. of Land Records & Agric., Bengal), pp. 1-78.

"*Brassica* spp. (Mustard): On the seeds of some species of Brassica & Sinapis, with reference especially to those of India," W. Kinzel (Transl. from Die Landw. Versuchs-Stationen, vol. 52, pp. 169-193) in Agric. Ledger, No. 7, 1901, pp. 103-127. pls. i.-ii.

"The Seed Coats of Certain species of Brassica," A. J. Pieters & Vera K. Charles, U.S. Dept. of Agric. Div. of Botany, Bull. No. 29, 1901, pp. 1-19, pl. i. ff. 1-6.

"Rape as a Forage Crop," A. S. Hitchcock, U.S. Dept. of Agric., Farmer's Bull. No. 164, 1903, pp. 1-16.

"*Brassica*" in Comm. Products of India, G. Watt (1908), pp. 174-186.

"Production and Utilisation of Rape Seed," in Bull. Imp. Inst. xiii., 1915, pp. 452-460.

"Rape (Colza, Ravison, Teri) and Mustard Seed" (Indian Trade in Oil-seeds), in Bull. Imp. Inst. xv., 1917, pp. 380-389.

Rosaceae.

Prunus Amygdalus, *Stokes*, var. **dulcis**; Sweet Almond.

A small tree; cultivated in the Mediterranean region—Southern Spain, France, Sicily, &c., in the Canary Islands, and California, for the kernels used for dessert. The best known in commerce are "Jordan" and "Valencia" Almonds, and supplies generally come chiefly from Spain (74944), Morocco (41913), Italy (22245), Portugal (14277), Canary Islands (5865), France (5529), Turkey in Asia (938), &c., to a total of 176,733 centals in 1913. The returns would probably include a proportion of "Bitter Almonds" (var. *amara*, Stokes), especially from Morocco (Mogador); these kernels cannot be eaten, as they contain prussic acid, their chief use is for the extraction of an oil used for flavouring liqueurs and in cookery. There are varieties of the Almond tree grown in gardens in Great Britain that also have eatable sweet kernels.

Prunus Avium, *Linn.*; Sweet Cherry. **Prunus Cerasus,** *Linn.*; Sour Cherry, Morello Cherry.

These are trees of good size in their wild state, and from them have been obtained the many excellent varieties that are now cultivated in orchards and gardens in most countries with a temperate climate, including Europe, North America, North Asia, Australia, Tasmania, New Zealand, &c. The Trade supplies of the fresh fruit in England (with an acreage of over 10,000 acres in 1917) were augmented in 1913 from France (31585), Holland (22726), Belgium (14434), Germany (993), &c., to a total of 69,739 centals.

2. June, 1917, "Investigations and Experimental Work carried on in Cherry Orchards in Kent," pp. 288-298.

Prunus Armeniaca, *Linn.*; Apricot.

A deciduous tree, probably native of China; naturalized in Afghanistan, Kashmir, &c.; grown in several varieties in gardens of Europe, North West India, China, Tibet, North America, &c., chiefly as wall fruits in the warmer parts. For Foreign and Colonial sources of fresh fruits see under "Peach" (*P. Persica*), and for dried fruits under "Prune" (*P. domestica*, var. *juliana*). Dried Apricot fruits are an important food in North West India, and pressed Apricot pulp is sold in bazaars in Damascus (Specimens in Museum, Kew).

Prunus Persica, *Stokes*; Peach (velvety skinned), Nectarine (smooth-skinned).

A deciduous tree, probably native of China. There are many varieties cultivated in temperate parts of Asia, Europe, America, &c., under glass or as wall fruits and in orchards in warmer climates. Fresh fruits are commonly sold in the markets of England, both home-grown and foreign; though always more or less of a luxury, and in America the Peach appears to be the most important commercially of all the stone fruits. Trade supplies of the fresh fruit into this country come chiefly from France, United States, Cape of Good Hope, &c., totalling in 1913, 10,653 centals; the returns also include Apricots.

2. Feb. 1908, "The Pruning of the Peach," pp. 661-669.

Prunus communis, *Huds.* (*P. domestica*, Linn.); Plum.

A small deciduous tree of Temperate Europe, Asia, America, &c. It includes many fine varieties and also the Damson and the Greengage. In addition to a good home trade, the imports of fresh plums have been chiefly from Germany, France, Holland, Belgium, Italy and United States, in 1913 amounting to 459,062 centals. Greengages also come from Spain, and see also under the following variety.

Prunus communis, *Linn.* var. **juliana,** (*P. domestica*, var. *juliana*, DC.); Prune, Prunier de St. Julien, French Plum.

A deciduous tree of temperate climates, largely grown in Central Europe—notably the Servian Valley, in France—Department of Lot and Gâronne, from whence it has been introduced to California, where the drying of the fruit is an important industry. There are several good varieties grown, but the principal one exported from Servia and France is "Prune d'Ente," and from California "Petite Prune d'Agen." "Italian Prune" and "d'Agen" are also grown in the States of North West America. The common French Plum used for stewing is "Prune St. Antoine." The imports into this country are included under "Fruit dried or otherwise preserved without sugar," together with "Plums," "Prunelloes," "Greengages," "Damsons," "Mirabelles," and "Apricots," coming chiefly from the United States (168013), France (18841)

Germany (17611), Austria-Hungary (10464), Canada (3822), Servia (1392), Holland, Italy, and Australia, in all amounting (1913) to 221,440 centals.

The "Quetsche" or "Quetschen" (*P. communis*, Huds., var. *pruneauliana*; *P. œconomica*, Borkh.) is an inferior kind of dried prune that was imported from Germany when French prunes were scarce.

1. 1890, "Production of Prunes in the South of France," pp. 263-269; 1892, "The Prune Industry of California," pp. 259-267, with plate of "Petite Prune d'Agen"; 1893, "Prune Cultivation in California," pp. 175-179.

2. June, 1901, "The Preparation of Prunes or French Plums," pp. 75-77; March, 1902, "Prune Growing in the United States," pp. 530-531.

The "Japanese Apricot" or "Mume Plum" (*P. Mume*, Sieb. & Zucc.), the "Japanese Plum" (*P. triflora*, Roxb.) of China and Japan, and the "Myrobalan" or "Cherry Plum" (*P. cerasifera*, Ehrh.), all have edible fruits of good quality, sometimes imported. The "Sloe" or "Blackthorn" (*P. spinosa*, Linn.), is best known for its use in the preparation of sloe gin. The salted flowers of *Prunus Pseudocerasus*, Lindl., are used as food in Japan.

Rubus Idaeus, *Linn.*; Raspberry.

A deciduous shrub about 5 ft. high, of Europe, Western Asia, &c., of which there are several varieties cultivated. The "Loganberry" is a hybrid between the "Raspberry" and a "Blackberry."

2. June, 1896, "Cultivation and Evaporation of Raspberries in the United States," pp. 54-59; Nov. 1906, "Cultivation of Raspberries," p. 497; Oct. 1910, "The Commercial Cultivation of the Loganberry," pp. 552-556, illustrated.

Included in the genus are the common "Blackberries" *Rubus fruticosus*, Linn., and *R. saxatilis*, Linn., of the hedgerows and *R. laciniatus*, Willd., of garden origin, the "Cloudberry" (*R. Chamaemorus*, Linn.), the "Dewberry" (*R. cæsius*, Linn.); the "Native Red Raspberry" (*R. strigosus*, Michx.), of Canada; improved kinds are the "Lowberry" and an American hybrid "Wilson Junior Blackberry," and several "Himalayan Rubi," including *R. ellipticus*, Smith, introduced to Queensland and Jamaica; *R. racemosus*, Roxb., introduced to Jamaica, and *R. rosaefolius*, Smith, introduced to Martinique and Dominica, are referred to (*K.B.* 1895, pp. 123-124) as yielding edible fruits.

Fragaria vesca, *Linn.*; Strawberry.

Perennial; cultivated in many temperate countries. The home trade in the fresh fruit is augmented from France (15864), Holland (979), and a comparatively small import from the Channel Islands (about 2 centals in the same year (1913) and 13 centals in 1912).

2. July, 1907, "Modern Strawberry Growing," pp. 193-205; June, 1909, "Strawberry Growing in Hampshire," pp. 186-193.

3. No. 207, 1913, "Strawberry Cultivation."

Pyrus communis, *Linn.*; Pear.

A deciduous tree of Europe and Western Asia. There are many varieties under cultivation,* and supplies of the fresh fruit have come from United States (277105), Belgium (269507), France (87886), Holland (73927), Canada (40110), Australia (28826), Germany, Cape of Good Hope and Channel Islands to a total of 805,199 centals for the year 1913. In addition to the use of this fruit for eating, the manufacture of "Perry" is of special importance in the counties of Gloucestershire, Worcestershire, Herefordshire and Monmouthshire.

2. Dec. 1903, "Cold Storage of Pears," pp. 398-401; March, 1909, "Varieties of Pears," pp. 940-941.

Pyrus Malus, *Linn.*; Apple.

A deciduous tree, widely distributed in temperate countries, including Europe, Western Asia, America, Australia, &c., and like the pear there are many varieties† under cultivation in Europe, Western Asia, America and Australia. Supplies of fresh fruit come chiefly from the United States (1552880), Canada (1415929), Australia, Holland, France, Belgium, Germany and Channel Islands to a total of 3,648,309 centals, the United States and Canada contributing each well over a million centals and therefore the largest share. The manufacture of cider is of importance in the counties of Devonshire, Cornwall, Herefordshire, Worcestershire, Somersetshire, Dorsetshire, Gloucestershire, Monmouthshire and Shropshire and also in Normandy. The Pomace is recommended for feeding stock.

The fruits of the cultivated forms of the "Crab Apple" (*P. Malus*, Linn.), the "Siberian Crab" (*P. baccata*, Linn.), and the "Mountain Ash" (*P. Aucuparia*, Gaertn.) are used for making jelly. The "Medlar" (*P. germanica*, Hook. f.) of Europe and Asia has a fruit unfit to eat in the fresh state, but is edible after being "bletted," in which condition it is commonly used.

2. Dec. 1904, "Utilisation of Cider Apples for Cattle Feeding," pp. 549-560; August 1917, "The Value of Cider Apples and Pomace as Food for Farm Stock," pp. 530-531; Oct. 1908, "Competition in Apple Growing," pp. 487-494, and numerous Papers on kindred subjects.

3. No. 134, 1905, "Apple Culture"; No. 211, 1908, "Cider Orchards"; No. 283, 1915, "Storage and Disposal of Apples and Pears."

Eriobotrya japonica, *Lindl*: Loquat, Japanese Medlar.

A small tree about 15 ft. high of China and Japan. Cultivated in Northern India, Southern France, Malta, Canary

* A Catalogue-Index of the known Varieties referred to in American Publications, from 1804 to 1907, of the United States Dept. of Agriculture (Bur. Pl. Industry, Bull. No. 126, 1908) covers 268 pages.

† A similar work of the Dept. (Bull. No. 56, 1905) in reference to Apples, 1804 to 1904, covers 395 pages.

See also *Kew Bull.* Nov. 1887, pp. 5–13, Canadian Apples and Pears.

Islands and other warm temperate or sub-tropical countries. A dessert fruit. The "Loquat" has been known in gardens of England for at least a century; Loudon (Encycl. Pl.) states that "to ripen it with flavour it requires the temperature of the stove, and comes into use in March."

Amongst other plants in the Order may be mentioned "Salad Burnet" (*Poterium Sanguisorba*, Linn.), a plant common on chalk downs and dry hills in England; recommended in mixtures for permanent pastures. "Quince" (*Cydonia vulgaris*, Pers.), "Japanese Quince" (*Cydonia japonica*, Thunb., and *C. Maulei*, T. Moore) (see *K.B.*, 1917, p. 339) used for making marmalade and jelly. The "June Berry" (*Amelanchier canadensis*, Medic.), sometimes used in North America for cakes and preserves. "Saskatoon Berry" (*Amelanchier alnifolia*, Nutt.) of Manitoba and North West Territories, fruits used fresh and preserved by settlers and Indians. The "Coco or Cocoa Plum" (*Chrysobalanus Icaco*, Linn.) of Tropical America, West Indies, and West Africa; fruit in the West Indies eaten fresh or preserved, and in Angola after being dried. The "Mola" or "Mobola" Plum (*Parinarium Mobola*, Oliv.), the "Ginger Bread Plum" (*P. macrophyllum*, Sabine) and *Parinarium curatellaefolium*, Planch.) of Tropical Africa, with edible fruits. The "Mexican Hawthorn" (*Crataegus pubescens*, H.B.K.) of Mexico, fruits edible and made into various kinds of preserves (K.B., 1914, pp. 289-298). "Ghanzalor" (*Crataegus Azarolus*, Linn.) of Malta and the Orient: fruits edible.

It is convenient to consider here **Saxifrageae,** which, though an extensive Order, contains only the "Gooseberry" and "Currant" of interest as fruits, usually classed with *Rosaceae* in "Small" or "Orchard" fruits.

Ribes Grossularia, *Linn.*; Gooseberry.

A shrub common in the Northern Hemisphere, where it is found wild in the North West Himalaya, Caucasus, Mountains of Greece, &c. There are numerous varieties under cultivation. In England this fruit is always looked forward to at Whitsun. Kent, Worcestershire and Middlesex are common centres of supply to the London Market Supplies of "Raw Gooseberries" also come from Holland (4924), Belgium (3646), France (474) in all for 1913, 9,056 centals.

It is remarkable that "the wild gooseberry of the Himalaya produces a small, hairy, very sour fruit which is most unpalatable, and is hardly ever eaten even by the natives"; but, on the other hand, the fruit of the wild variety of "Black Currant" is said to be "very like that of the cultivated black currant, and quite as large and very palatable" (Watt). The "Wild Black Currants" (*Ribes Hudsonianum*, Rich., & *R. americanum*, Mill.) of North West Canada are also highly esteemed for their fruit (*K.B.* Nov. 1887, p. 16), and also the "Wild Smooth Gooseberry" (*R. oxycanthoides*, Linn.) of Canada is said to have a small fruit of good flavour (l.c. p. 18). The last-mentioned is the parent of the American Garden Gooseberries.

Ribes nigrum, *Linn.*; Black Currant. **R. rubrum,** *Linn.*; Red Currant and **R. rubrum,** *Linn.*, var. **album,** *Desf.*; White Currant.

Small shrubs of Northern Europe and Northern Asia, Johnson & Sowerby (Useful Pl. Gt. Britain) record Britain as a native country of *nigrum* and probably also of *rubrum*.

Several varieties of the Red and Black are under cultivation. Supplies of the fresh fruit from abroad have come chiefly from Holland (56465), France (49296), Germany and Belgium, totalling in 1913, 121,734 centals.

The following references, as bearing generally on these two Orders, may be of interest:—

Journal of the Board of Agriculture:—"English Orchards," June, 1898, pp. 1-10, Sept. 1898, pp. 145-151, Dec., 1898. pp. 319-325. "Fruit Preservation," June, 1901, pp. 61-63. "Planting Fruit Trees and Bushes," Nov. 1904, pp. 449-458. "Training and Pruning Fruit Trees and Bushes," Dec. 1904, pp. 522-528. "Preparation of Fruit Pulp in France," Jan. 1905, pp. 621-624. "Drying or Evaporating Fruit," March, 1906, pp. 756-759. "Pruning Fruit Trees," March, 1908, pp. 705-711; April, 1908, pp. 22-30. "Notes on the Time of Blossoming of Fruit Trees," Dec. 1908, pp. 678-686; April, 1910, pp. 32-38; "Root-Pruning Fruit Trees," July, 1909, pp. 290-293. "Small Fruit Growing in Kent," Nov. 1909, pp. 628-635. "Fruit Farming in West Kent," Jan. 1911, pp. 811-815. "Fruit Bottling," March, 1911, pp. 977-981. "Fruit Preserving for Small Market Growers or for Domestic Use," Aug. 1915, pp. 447-450. "The Making of Fruit Pulp," pp. 450-453.

Board of Agric. Leaflet, No. 148, 1908, "Planting Fruit Trees and Bushes." No. 162, 1915, "Grafting Fruit Trees." No. 70, 1916, "The Treatment of Neglected Orchards." Special Leaflet No. 5, 1914, "Fruit Preserving for Small Market Growers or for Domestic Use." No. 31, 1917, "The Making of Fruit Pulp."

"The Apples of New York," S. H. Beach, N. O. Book, & O. M. Taylor, vol. i. pp. 1-409, vol. ii. pp. 1-360 (J. B. Lyon Co., Albany, New York, 1905); illustrated with coloured plates.

"The Plums of New York," U. P. Hedrick, pp. 1-616 (1911).

"The Cherries of New York," *idem*, pp. 1-371 (1915).

"The Peaches of New York," *idem*, pp. 1-541 (1917); all illustrated by coloured plates (J. B. Lyon Co., Albany, New York).

"British Apples: Report of the Committee of the National Apple Congress," A. F. Barron, 5 plates (London, 1884).

"Pears: Report of the Committee of the National Pear Conference," *idem*, in Journ. Roy. Hort. Soc. ix. 1887, pp. 1-230.

"Apple and Pear Conference, 1888" in Journ. Roy. Hort. Soc. x. 1888, pp. 1-376, with descriptive catalogue of Apples exhibited and statistical and other information relating to the cultivation of Apples in Great Britain and Ireland.

"Conference on Fruit Growing" in Journ. Roy. Hort. Soc. xxx. 1906, pp. 1-166, with a Table of the Acreage under Fruit

Cultivation in England, Wales, and Scotland, and Map showing acreage of fruit in each County.

"Bush Fruits: A Horticultural Monograph of Raspberries, Dewberries, Currants, Gooseberries, and other shrub-like Fruits," F. W. Card, pp. 1-537; illustrated (New York, 1907).

"Apples and Pears," by G. Bunyard, pp. 1-116, illustrated, col. plates (T. C. & E. C. Jack, London & Edinburgh).

"A Guide to the Literature of Pomology," E. A. Bunyard in Journ. Roy. Hort. Soc. xl. 1914-15, pp. 414-449.

ANONACEAE.

Anona Cherimolia, *Mill.*; Cherimoyer.

A small tree, 10 to 15 ft. high, native of the Andes of Ecuador and Peru; cultivated for the fruit in various sub-tropical countries.

Anona muricata, *Linn.*; Soursop.

A small tree, about 10 ft. high, of the West Indies, Tropical America and Africa and other tropical countries; fruit commonly sold in the native markets.

Anona reticulata, *Linn.*; Custard Apple, Bullock's Heart.

A small tree, upwards of 20 ft., native of Tropical America and West Indies; cultivated in India, Africa, &c., for the fruit.

Anona squamosa, *Linn.*; Sweet Sop, Sugar Apple, Custard Apple (India).

A small tree, upwards of 20 ft., native of South America and the West Indies; cultivated in India, Africa, &c., for the fruit.

These fruits are practically unknown in this country—though "Custard Apple" has been noted on sale in Liverpool (K.B. 1908, p. 189)—as they are not suitable for shipment; but in the countries of production they are of importance. The original form of the generic name was "*Annona*," which implies means of subsistence.

1. Aug. 1887, "Cherimoyer," pp. 15-16.
1a. ix. 1 (1908) "*Anona*," pp. 47-49.

CAPPARIDEAE.

Capparis spinosa, *Linn.*; Caper.

A scrambling shrub, native of the Mediterranean region. Cultivated in France, Spain, Algeria, Italy, Sicily, &c., whence the floral buds, well known as "Capers" are imported into this country, shipped chiefly from Marseilles and Bordeaux, those from Roquevaire in France being the most important.

The "Queensland Pomegranate" (*Capparis Mitchelli*, Lindl.) has an edible fruit. Recently several enquiries have been made at Kew as to the suitability of the fruits of the "Caper Spurge" (*Euphorbia Lathyris*, Linn.), a common weed in this country for pickling in the same way as the ordinary Caper; but being more or less poisonous they cannot be recommended as a substitute.

1. 1898, "Caper Industry in France," pp. 31-32.
2. Sept. 1897, "The Caper Industry of Roquevaire," pp. 221-223.

GUTTIFERAE.

Garcinia Mangostana, *Linn.*; Mangosteen.

A small tree, 20 to 30 ft. high, native of the Malay Peninsula; cultivated in Ceylon, parts of India, and the West Indies. One of the choicest of tropical fruits, regularly shipped from Singapore to Calcutta; but so far attempts to introduce this fruit to the European markets have not been successful, beyond the fact that they have been favourably reported on after travelling from Trinidad (1897), where the first West Indian Fruits were produced in 1875. In Jamaica the Mangosteen fruited for the first time in 1886, the plants in both instances being distributed from Kew. The fruit of the "Wild Mangosteen" (*G. indica*, Chois.) is eaten in India.

1. 1898, "Mangosteens from the West Indies," pp. 26-27.

1a. ix. 1 (1908) pp. 64-65.

The Order includes the "Butter & Tallow Tree" (*Pentadesma butyracea*, Don.), a tree of West Africa; yields a fat from the seeds used by the natives of Sierra Leone for cooking, and the "Mammee Apple" (*Mammea americana*, Linn.), a large tree of the West Indies, with an edible fruit.

TERNSTROEMIACEAE.

Caryocar nuciferum, *Linn.*, **C. tomentosum,** *Willd.*; Souari Nuts, Butter Nuts.

Large trees, native of South America. The kernels are valued as dessert nuts. A large supply of nuts of *C. nuciferum* was received at Kew in 1891 from the Botanical Gardens, Demerara, and distributed to various Colonial Gardens (*K.B.* 1891, p. 277: 1892, p. 75).

Camellia Thea, *Link.* (*Thea chinensis*, Sims); Tea.

A shrub, probably native of Assam and China. Cultivated principally in British India (2034593), Ceylon (1109364), Java (216744), and China (161632), the figures stated being the share of each country out of a total importation in 1913 of 3,650,434 centals. The British Possessions contributed out of this amount 3,147,627 centals, in addition to the first two mentioned above, they were South Africa, Nyasaland, Straits Settlements, Hong Kong, Australia, Canada, and the West Indies. The foreign countries contributing the remainder of 502,807 centals were, including Java and China, chiefly United States, Japan, Russia, Argentine, &c. Various blends of tea are sold, but broadly they are classed as "China," "Ceylon," and "Indian." "Canton Scented Orange Peko" and "Gunpowder" green tea are special kinds supplied for flavouring. There is in the Museum at Kew a very full series of the teas of commerce.

1. 1888, "Jamaica and Natal Tea," pp. 86-88; 1889, "Puerh Tea," pp. 118-120; 1890, "Compressed or Tablet Tea," pp. 109-112; 1892, "Lao Tea," pp. 219-222; 1892, "Mauritius Tea," pp. 234-238; 1895, "Tea Cultivation in the Caucasus," pp. 58-61; 1896, "Leppett Tea," pp. 10-16; "White Tea of Persia," pp. 157-158.

MALVACEAE.

Hibiscus esculentus, *Linn.*; Ochro (W. Africa & W. Indies), Edible Hibiscus, Lady's Fingers.

A shrub, native of India; distributed to Tropical Africa and naturalized in all tropical and many sub-tropical countries. The young pods are used everywhere as a vegetable. In India the mature fruits are used to make curry and the leaves are recommended as cattle fodder.

1a. ix. 1 (1908) pp. 71-72.

Hibiscus Sabdariffa, *Linn.*; Rozelle, Red Sorrel, Indian Sorrel.

A shrub cultivated in Tropical Africa and most tropical countries. The fleshy calyces are made into a preserve, the leaves are used as a pot-herb, and the seeds are a good food for cattle.

1a. ix. 1 (1908), p. 74.

Gossypium spp.; Cotton Seed.

Annuals or perennial plants grown as annuals, widely cultivated in tropical and sub-tropical countries for the cotton fibre, and most if not all of the countries export or utilise the seed. It yields on crushing a yellow oil, which when refined may be used in the manufacture of oleo-margarine, as a salad oil, and as a substitute for olive oil. When bleached it is used in the preparation of a substitute for lard. The cake made from the seeds after the expression of the oil is a valuable feeding material for cattle, as also is the meal mixed with the hulls. Cotton seed is imported from Egypt, United States, West Indies, British India, East and West Africa, Uganda, Peru, Brazil, Colombia, Russia, China, Turkey, &c., and in 1913 the amount was 13,783,436 centals. Cotton Seed Cake—5,302,595 centals from Germany, France, Austria-Hungary, Egypt, Turkey in Asia, United States, Mexico, Peru, Brazil, British East Indies, &c., and Cotton Seed Oil, refined and unrefined—395,494 centals, the greater proportion (356406) being imported in the same year from the United States.

1a. ix. 1 (1908), "*Gossypium*," pp. 76-85.

2. Sept. 1898, "Effects on Butter of Cotton Seed and Sesame Seed Oil Cake," pp. 205-208; June, 1901, "Feeding Value of Cotton Cake and Cotton Seed Meal," pp. 41-43.

The seeds of "Kapok" (*Eriodendron anfractuosum*, DC.) yield an edible oil, and the cake made from the residue is said to compare very favourably with ordinary cotton seed cake for feeding cattle.

The "Durian" (*Durio Zibethinus*, Linn.), a tree of Malacca and the Malay Islands, is considered one of the finest of tropical fruits, provided the taste is acquired and the objectionable flavour and odour is first overcome.

STERCULIACEAE.

Theobroma Cacao, *Linn.*; Cocoa or Cacao.

A tree, 20 ft. and upwards, native of Tropical America; cultivated in many tropical countries. Raw cocoa is imported from

British West Africa (203246), British West Indies (160336), Brazil (128966), Ecuador (89230), Ceylon (50511), Togoland and Cameroons (15777), Venezuela (7261), Java (6238), Costa Rica (5370), British Honduras, Seychelles, British Guiana, &c., in all for 1913, 783,595 centals. The uses of the bean in the preparation of chocolate and as a beverage are well known, and "Cocoa Butter" is also an important food product, Holland supplying in 1913—19,326 centals, smaller quantities coming from Germany, United States and Brazil.

Experiments in Denmark and Germany in the feeding of horses and cattle with the shells and cake residues from cocoa manufacture show them to be poisonous and therefore not to be recommended.

1. 1890, "Cacao Cultivation in Ceylon," pp. 170-173; 1893, *ibid.* Grenada pp. 136-139; 1895, *ibid.* "Gold Coast," pp. 13, 22; 1899, "Cacao in Ecuador," pp. 42-45.

1a. ix. 1 (1908), pp. 96-104.

2. Aug. 1916, "The Poisonous Properties of Cacao Shells," p. 498.

The "Kola Nut" (*Cola acuminata*, Schott & Endl.), a tree native of West Africa, is used chiefly as a stimulant, but the nut forms an important item socially and dietetically in the daily life of the West African native. In Europe preparations of the nut are said to be efficient substitutes for tea or coffee.

1. 1890, pp. 253-260; 1906, pp. 89-91.

1a. ix. 1 (1908), pp. 91-95.

Lineae.

Linum usitatissimum, *Linn.*; Flax, Linseed.

Annual, 1½ to 3 ft. high; cultivated in many temperate countries. The seed is used for the extraction of oil for various industrial purposes, and the residual cake is an important feeding stuff for cattle; though it appears to have, at times, been the cause of poisoning. The occasions when this has happened, however, seem to be rare, due probably to the fact that the cake is usually fed as part of a mixed ration.

The imports of Linseed come chiefly from Argentine (4687762), Canada (5314953) British India (2841063), Russia (412867), United States (178614), Holland (56522), Belgium (22152), Uruguay, China, Morocco, Turkey, &c., to the amount in 1913 of 13,620,098 centals. Linseed cake imported in the same year amounted to 1,874,409 centals.

1. 1913, "Flax (Fibre & Seed)," pp. 319-335.

2. Dec., 1896, "The Antwerp Linseed Trade," p. 320; Jan., 1906, "Supply of Linseed Cake in the United Kingdom," pp. 610-613; Feb., 1911, "The Formation of Hydrocyanic Acid from Linseed Cake," pp. 904-907; April, 1912, "Growth of Linseed for Feeding Purposes," pp. 30-33; Sept., 1912, "The Formation of Prussic Acid from Linseed Cake and other Feeding Stuffs," pp. 446-460; Nov., 1912, "Hydrocyanic Acid from Linseed Cake," pp. 657-660; Aug., 1913, "The Growing of Linseed for Feeding Purposes," pp. 377-385; May, 1915, "The Feeding

of Linseed to Calves," pp. 120-121; May, 1918, p. 217; Feb., 1916, "Linseed as a Farm Crop," pp. 1069-1080.

3. No. 278, 1913, "The Growing of Linseed for Feeding Purposes."

Rutaceae.

Citrus Aurantium, *Linn.*; Sweet Orange. **C. Aurantium,** *Linn.* var. **Bigaradia**; Bitter or Seville Orange. **C. decumana,** *Murr.*; Shaddock, Pumelo or Pomelo, Grape Fruit. **C. Medica,** *Linn.*; Citron. **C. Medica,** var. **acida**; Lime. **C. Medica** var. **limonum**; Lemon.

Small trees of tropical and sub-tropical countries, the Shaddock and the Lime being perhaps more suited to tropical, and the Orange, Lemon and Citron to sub-tropical conditions.

Oranges are imported chiefly from Spain (5624681), Portugal, Italy, Asiatic Turkey, Egypt, United States, Cape of Good Hope and British West Indies, over 5 to 6 million centals a year, Spain, as indicated in the figures above for 1913, supplying the greater share. Lemons, Limes and Citrons are classed together in the Customs Returns as coming from Germany, Spain (probably all Lemons and Citrons), Italy (Lemons chiefly), and British West Indies (probably all Limes) to the amount of over 700,000 centals a year. Other well-known *Citrus* fruits are "Blood" or "Maltese" Orange (*C. Aurantium* var. *melitensis*), "Tangerine" (*C. Aurantium* var. *nobilis*) and "Kumquat" (*C. Aurantium* var. *japonica*).

1. 1894, "West Indian Lime," pp. 113-116; "Jaffa Orange," pp. 117-119. 1895, "Orange Growing in Florida and Jamaica," pp. 125-126; "Citrus Fruits in Sicily," pp. 266-271. 1900. "Metford's Lemon," pp. 28-29.

1a. ix. 1 (1908), "*Citrus*," pp. 122-136.

Ilicineae.

Ilex paraguensis, *St. Hil.*; Paraguay Tea.

A shrub, native of Paraguay. Leaves infused like tea, used in South America, where it is an important product, and several million pounds are exported. "Paraguay tea is now advertised for sale in this country and appears to be in moderate demand, possibly as a curiosity more than as a regular article of food"—this statement was made in 1898, and it is probable that the same conditions hold good to-day.

1. 1892, pp. 132-137; 1898, pp. 142-143.

Ampelideae.

Vitis vinifera, *Linn.*; Grape. **V. vinifera,** *Linn.* var. **corinthiaca**; Currant.

A vine, cultivated in Southern Europe, North Africa, South Africa, Canary Islands, Syria, United States, South America, Australia, &c., largely for the production of wine, of which the United Kingdom imported in 1913, 12,332,912 gallons, France, Portugal and Spain contributing more than 3,000,000 gallons each. Raisins to the amount of 826,728 centals were imported in the same year, the greater proportion coming from

Spain, Turkey in Asia, Greece and Australia; of Currants—1,459,142 centals were imported, Greece supplying no less than 1,452,543 centals of the whole; and of fresh Grapes, the home supply (grown under glass) was augmented in the same year from Spain (554548), Portugal (49330), Channel Islands (16264), Belgium (15121), Holland, Cape of Good Hope, &c., to a total of 652,441 centals.

1. 1888, "Cochin China Vine" (*Vitis Martini*, Planch.), pp. 134-135; 1889, "Vine Cultivation in the Gironde," pp. 227-230; 1894, "Viticulture in Malaga," pp. 34-36; 1897, "Wine Production in France," pp. 201-203.

Sapindaceae.

Acer saccharinum, *Wangh.*; Sugar Maple.

A tree upwards of 100 ft. high with a trunk 3 or 4 ft. in diam., native of the United States and Canada. The production of Maple Sugar and Syrup appears to be confined to the countries mentioned. The tree was introduced to England in 1735. Seeds specially obtained from Philadelphia were despatched from Kew to Kashmir about 20 years or so ago. The Sycamore (*Acer Pseudoplatanus*, Linn.), abundant in this country has long been known to yield sugar, but not in paying quantities, and only recently (1918) a correspondent of the Director of Kew made a fair trial with some trees on his estate; but finally gave it up as impracticable.

1. 1895, "Maple Sugar (*Acer saccharinum*)," pp. 127-128; 1911, "The Sugar Maple," pp. 303-304.

The fruits of "Horse Chestnut" (*Aesculus Hippocastanum*, Linn.) are said to be used in Switzerland and Turkey for feeding sheep, horses, &c. The fruits of "Litchis" (*Nephelium Litchi*, Camb.) and "Longans" (*N. Longana*, Camb.) of China and the East Indies are sometimes imported into this country for dessert.

"Akee Apple" (*Blighia sapida*, Koenig.), a tree of West Africa and West Indies, has the seeds set in a creamy white arillus which is edible, and when cooked forms a very palatable food; but unless quite fresh this is decidedly unwholesome and sometimes poisonous.

The fruits of the "Lac Tree" or "Kosumba" (*Schleichera trijuga*, Willd.), a large deciduous tree of India & Ceylon, are edible; the seeds in commerce are of greater value for the oil they yield; but "the jungle tribes in times of scarcity gather the fruits for their own consumption rather than for trade purposes" (Watt).

1. 1899, "Lungan Pulp," pp. 219-220.

1a. ix. 1 (1908) "*Blighia sapida*," pp. 167-168.

Anacardiaceae.

Pistacia vera, *Linn.*; Pistachio Nut.

A small tree of Syria, Mesopotamia and Persia: cultivated in Sicily and other parts of Southern Europe from whence they are imported into this country. Eaten in fig-cakes in Cyprus

and Greece, and in England sold by grocers for use like almonds or in confectionery.

1. 1890, "Pistachio Cultivation in Cyprus" and "at Aleppo" pp. 69-71.

Mangifera indica, *Linn.;* Mango.

A tree 50-60 ft. high, native of the East Indies and Malaya; naturalized in Tropical America, Asia and Africa. There are many choice varieties under cultivation. The fruits as well as being eaten fresh are used in large quantities in India in the manufacture of chutney, which comes into the English and American markets. Consignments of fresh fruits from Jamaica and India have been made with success; but no regular trade has been developed. Ripe mangoes preserved in syrup may be had in this country.

1a. ix. 1 (1908) pp. 169-175.

Anacardium occidentale, *Linn.*, Cashew Nut, Cashew Apple.

A small tree, indigenous to South America and the West Indies; introduced to Tropical Africa and many warm countries. The roasted kernels are commonly eaten as dessert, for which purpose they are exported from India to the United Kingdom and France. The juicy, fleshy pedicel may also be eaten when ripe, and from it may also be distilled a spirit which in some parts, notably Mozambique, Portuguese East Africa, is an important beverage.

1. 1898, "Cashew Spirit," pp. 28-29.

1a. ix. 1 (1908), pp. 175-176.

In this Order mention may also be made of the "Golden Apple" or "Otaheite Apple" (*Spondias dulcis*, Willd.), a tree from 50 to 60 ft. high of the Society Islands and Fiji Islands, and "Purple Spanish Plum" (*S. purpurea*, Linn.) of the West Indies, with edible fruits.

Myrtaceae.

Psidium Guayava, *Linn.*; Guava.

A small tree, native of Tropical America; naturalized in many tropical countries.

The fruit is well known as one of the best of tropical fruits, eaten fresh and largely used in the West Indies for making jelly. The fresh fruits, because of their tendency to decay quickly when ripe do not come into the markets of this country; but it is possible to obtain various forms of preserves, "Guava Jelly," "Guava Cheese," &c., that are supplied chiefly from the West Indies.

The "Purple-fruited Guava" or "Chinese Guava" (*P. Cattleianum*, Sabine), a small tree native of Brazil, grown in China, &c., has a fruit which is said to be superior to the foregoing.

1a. ix. 2 (1911) pp. 315-316.

Eugenia caryophyllata, *Thunb.*; Clove.

An evergreen tree, 30 to 40 ft. high, native of the Moluccas,

cultivated in Java, India, West Indies, Zanzibar, Pemba, &c.

The flower buds are the cloves of commerce, of which Zanzibar and Pemba probably supply the greater part. Under "Species Unemerated" the Customs Returns give for 1913, 44,849 centals from these islands out of a total from all sources of 88,818 centals.

1. 1893, "Clove Industry of Zanzibar," pp. 17-20.

1a. ix. 2 (1911) pp. 318-319.

The "Rose Apple" (*Eugenia Jambos*, Linn.), a tree 20 to 30 ft. high, and the "Malay Apple" (*E. malaccensis*, Linn.), a shrub 6 to 8 ft., natives of Tropical Asia, East Indies, &c., and the "Pitanga Cherry" (*E. uniflora*, Linn.) of Brazil, all have edible fruits.

Pimenta officinalis, *Lindley*; Allspice, Pimento, Jamaica Pepper.

A tree 20 to 30 ft. high, native of the West Indies, extending to Central America and under cultivation in many tropical countries. The dried unripe fruits are used as a spice, Jamaica being the principal source of supply to this country.

1a. ix. 2 (1911) pp. 317-318.

Bertholletia excelsa, *H. & B.*; Brazil Nut.

A large tree of the Amazon region; introduced to the Botanic Gardens of Ceylon (1880), Singapore (1881), and Brisbane (1885) from the Royal Gardens, Kew, to Jamaica (1881), and Trinidad (prior to 1862—nuts exhibited at the Inter. Exhib. London, 1862) from the mainland, where specimen trees can now be seen in fruit yearly.

Lecythis Ollaria, *Linn.*, and **L. Zabucajo,** *Aubl.*; Sapucaia Nuts.

Large trees of Brazil and Guiana. Similar efforts have been made to introduce the "Sapucaia" nut trees to other countries, but so far apparently without success, no record being available of trees having grown to maturity. In Trinidad, perhaps the best Colony in which to expect success, it is stated (Bull. Dept. Agric., Trinidad & Tobago, part 1, 1918, p. 27) in reference to *Lecythis Zabucajo*, "No fruiting trees are known in the Colony. A short time ago seed was obtained and plants of it raised in the St. Clair Nurseries, for distribution. Some of these have made good growth in wet districts. At Port of Spain they failed."

"Brazil" and "Sapucaia" nuts are imported into the United Kingdom from the native countries mentioned and are well known for their use as dessert nuts.

1. Dec., 1887, "Introduction of the Brazil Nut to the East Indies and Australia," pp. 11-13.

The fruits of *Napoleona imperialis*, Beauv., a shrubby tree of West Africa, are eaten by the natives.

LYTHRARIEAE.

Punica granatum, *Linn.*; Pomegranate.

A small tree, native of Southern Europe and Western Asia; largely cultivated in the Tropics and Sub-tropics. The fruit

is one of the oldest known—since 1491 B.C. (Smith); it is commonly imported into this country, though not in large quantities.

1a. ix. 2 (1911) pp. 323-324.

Onagrarieae.

Trapa bispinosa, *Roxb.*; Singhara Nut.

An aquatic plant of Tropical Africa, India and Ceylon. The nuts are an important food in Kashmir, India, Tropical East Africa—Lukugu River, Zambesi River, &c., West Africa—Yola, cultivated in lakes, pools and tanks.

Trapa natans, *Linn.*; Water Chestnut, Jesuit's Nut, Water Caltrops, Gnar Nuts, Ling (China).

An aquatic plant, widely distributed in Central Europe, Temperate Asia, and in Africa—Upper Nile and Victoria Nyanza regions. The seed is farinaceous and may be eaten raw, roasted, or in soups, an important food in the countries where grown.

1a. ix. 2 (1911) "*Trapa*," pp. 324-325.

Passifloreae.

Passiflora edulis, *Sims*; Purple-fruited Passion Flower, Mountain Sweet Cup. **P. laurifolia,** *Linn.*; Bell Apple. **P. quadrangularis,** *Linn.*; Granadilla.

Climbing plants, native of Tropical America, commonly cultivated in the Tropics and warm countries. Edible fruits, those of the Granadilla being usually sold in the Paris markets and occasionally in the London markets.

1a. ix. 2 (1911) "*Passiflora*," pp. 325-327.

Carica Papaya, *Linn.*; Papaw, Melon Tree.

A small tree, 15 to 20 ft. high, commonly cultivated in the Tropics, often self-sown on rubbish heaps and odd corners in the neighbourhood of native dwellings and farms. The fruits may be eaten when ripe as dessert, cooked when young and green as a vegetable, or pickled in the green state.

1a. ix. 2 (1911) pp. 327-329.

Cucurbitaceae.

Cucumis Melo, *Linn.*; Melon, Sweet Melon, Musk Melon, Nutmeg or Netted Melon, Cantaloup.

Native probably of Bokhara; cultivated in many warm countries and well known as a dessert fruit. In Afghanistan, where Melons are largely cultivated as a field crop, the "Sarda Melon" is exported to India, and it has been recommended for importation into this country for use in the winter, the full flavour being developed on keeping for a time after exposure to a low temperature. Two fruits were sent to the Director, Kew, by Dr. Aitchison from Kabul, and the report on them was that "they arrived at the beginning of January (1894) in excellent condition, carefully packed in cotton wool: the flesh, though firmer than that of the melons ordinarily cultivated in

this country, amply justified in flavour the reputation which this fine fruit enjoys throughout India." Fruit grown at the Royal Gardens, Frogmore, from seeds distributed by Kew, was described as "10 in. long, 7 in. diam., skin yellowish green and netted, the wall of flesh 2 in. thick, and rich in flavour as well as sweet and juicy."

1. 1894, "Sarda Melon," pp. 75-76.

Cucumis sativus, *Linn.*; Cucumber.

Well known in gardens everywhere; used green for salads and pickles. The early season trade for the market gardeners at home has been reduced in importance by the development of shipments from Holland. There appears to be a good trade in pickled fruits of "Gherkins" or "Concombre de Russie" (Vilmorin) from Russia and "Boston Pickling" or "Green Prolific" from America, which seems to pay better than the fresh fruits.

Citrullus vulgaris, *Schrad.*; Water Melon, Canadian Citron, Citron Water Melon.

Climbing annual, widely distributed in warm countries. The fruit is well known for its watery, refreshing pulp when ripe, and as a vegetable when green. Large supplies of Water-melons in normal times come into the markets of this country from Spain and Portugal.

Cucurbita Pepo, *DC.*; Pumpkin, Vegetable Marrow (sometimes distinguished as var. *ovifera*).

Climbing annuals, cultivated in many hot countries and in temperate countries during the summer months. Pumpkins and Vegetable Marrows are well known as vegetables, and Pumpkins are good food for pigs and cattle, and are also recommended for sheep. The seeds cracked small are recommended for feeding poultry.

The fruits of the "Calabash Gourd" or "Melon Pumpkin" (*C. maxima*, Duchesne) and the "Portmanteau Gourd" or "Naples Gourd" (*C. moschata*, Duchesne) are cultivated in many hot countries, including India, where they are stated to be used as a vegetable.

Sechium edule, *Swartz.*; Vegetable Pear, Choko, Chayote, Madeira Marrow, One-seeded Cucumber.

A perennial plant with tuberous rootstocks, native of the West Indies, commonly cultivated in the Tropics. Fruit eaten as a vegetable. The tuberous roots are edible, starch made from them is recommended as a substitute for "Arrowroot" (*Maranta arundinacea*), and the young shoots may be eaten cooked like "Asparagus." The green vines are good fodder.

1. Aug., 1887, "Chocho," pp. 6-9; 1896, p. 128.

Lagenaria vulgaris, *Seringe*; Bottle Gourd, Calabash Gourd, Pipe Calabash, Club Gourd.

Climbing annual, cosmopolitan in the Tropics and Sub-tropics

of both hemispheres. Some of the fruits of the numerous varieties are of doubtful quality, but others may be eaten freely. Heckel states that the pulp surrounding the seeds is poisonous and the juice violently purgative. In Japan the gourd is used as food after being thoroughly dried, the ends of the fruit are cut off, the seeds and pulp taken out, the outer or fleshy part cut into very thin slices and dried by hanging on sticks, in which condition it keeps for a considerable time. A sample of this "sliced and dried fruit" is in the Museum at Kew, from the Japan-British Exhibition, 1910. The gourd is cultivated in Japan for the purpose.

Telfairia occidentalis, Hook. f., of West Africa, and *T. pedata*, Hook. of East Africa are perennial climbing plants, cultivated for the seeds by the natives for food. The "Wax Gourd" (*Benincasa cerifera*, Savi.), cultivated in many warm countries, including Africa, India, China, Japan, Philippines, &c.; the fruit is commonly eaten like the vegetable marrow, used in curry or made into sweet-meat. The fruits of *Cephalandra indica*, Naud., of India, Java, Africa, &c., are eaten both raw and cooked, fresh when ripe and in curries, and as a vegetable when green.

1a. ix. 2 (1911), "*Cucurbitaceae*," pp. 329-340.

Cactaceae.

Opuntia spp.; Prickly Pear.

Succulent shrubs, 3 to 6 ft. high, native of the dry regions of Tropical America; grown in Texas, California, Arizona, and New Mexico. Various species have been introduced to Southern Europe, North and South Africa, Canary Islands, Madeira, India, and many other hot countries for the fruit.

There are several species that are esteemed for their excellent fruit in Mexico, where they are cultivated, distinguished as "white," "yellow," and "crimson," and one called "Xoconostle"—the fruit of which makes a most delicious preserve (*K.B.* 1892, p. 147). Various species, especially those that are nearly spineless, are used for feeding stock; but, although the yield is heavy, 20 tons and upwards, the feeding value is given as low, since from 80 to 90 per cent. of the plant is water. They are of importance as forage in regions so hot and dry that little else will grow there, and one has to remember in any movement to distribute them, that in many countries, South Africa, Australia, &c., where the "Prickly Pear" has been introduced, legislative measures, sooner or later, have been taken to destroy the plant or to keep it under control. The "Pelona," with yellow and crimson fruit, is by reason of its almost spineless character of special value in Mexico as a forage plant.

Cereus giganteus, Engl., and *C. Thurberi*, Engl., have edible fruits much esteemed by the Indians of New Mexico and Arizona.

J. 1888, "Prickly Pear in South Africa," pp. 165-173; 1890, *ibid.*, pp. 186-188, including extract from the Minutes of the Committee on the Eradication of the Prickly Pear; 1892; "Prickly Pear in Mexico," pp. 144-148; 1912, "Opuntias in the Canary Islands," pp. 395-396.

UMBELLIFERAE.

Carum Carvi, *Linn.*; Caraway.

Biennial, upwards of 2 ft. high, of Northern and Central Europe and Western Asia; naturalized in England, where it is cultivated to a limited extent in Essex and Kent; cultivated in Holland, North Russia, &c., whence the market is chiefly supplied. The fruits known as "Caraway Seeds" are well known for their use in confectionery and for flavouring liqueurs—"Kummel," a Russian preparation, especially. The fruits of "Dill" (*Peucedanum graveolens*, Bth.), an annual of Southern Europe, cultivated in England as a medicinal plant, have recently been submitted to Kew for identification, having been found in confectionery as a substitute in the present shortage of "Caraway."

2. May, 1911, "The Caraway Industry in Holland," pp. 134-137.

"Celery" (*Apium graveolens*, Linn.), "Carrot" (*Daucus Carota*, Linn.), "Parsnip" (*Peucedanum sativum*, Bth. & Hook.), "Parsley" (*Carum Petroselinum*, Bth.), "Fennel" (*Foeniculum vulgare*, Mill.), are all well-known garden plants in this Order. "Angelica" (*Archangelica officinalis*, Hoffm.), is cultivated in France for its leaf-stalks, usually candied with sugar and eaten as a sweetmeat. The "Hay Plant" (*Prangos pabularia*, Lindl.), of Tibet, is used in that country as a fodder plant. The roots of the "Sea Holly" (*Eryngium maritimum*, Linn.), a sea coast plant of Britain, are sometimes preserved in sugar and eaten as a sweetmeat. "Arracacha" (*Arracacia xanthorrhiza*, Bancr.) of the Andes, where it is cultivated for the tuberous roots, used as a vegetable; naturalized in Jamaica and used for a similar purpose.

1. Aug., 1887, "Arracacha" (*Arracacia esculenta*, DC.), pp. 10-15.

2. Sept., 1897, "Introduction of the Carrot into England," pp. 225-227; Sept., 1913, "The Cultivation of Carrots," pp. 503-507; July, 1916, "Carrots and Turnips as Catch Crops," pp. 366-367; Dec., 1913, "The Cultivation of Celery," pp. 793-796.

3a. No. 70, 1917, "The Cultivation of Parsnips."

RUBIACEAE.

Coffea arabica, *Linn.*; Arabian Coffee, Maragogipe Coffee, Mocha Coffee. **C. liberica,** *Bull.*; Liberian Coffee. **C. robusta,** *Linden*; Robusta Coffee, Rio Nunez Coffee, Congo Coffee. **C. stenophylla,** *G. Don.*; Highland Coffee of Sierra Leone.

Shrubs or small trees cultivated in various parts of the Tropics, the last-mentioned, although widely distributed from Kew to the Colonies, being perhaps the most limited as a trade source. Coffee as a beverage is well known; it was one of the earliest introduced into this country, the first London coffee house being established in St. Michael's Alley about 1652. It had been used in Constantinople for more than a century before. This would refer to Arabian coffee. The principal sources of the green berry are in general, Brazil (289307), Costa Rica (215264), Colombia (102811), Gautemala (97748), British India (75531), Nicaragua,

Mexico, San Salvador, Portuguese Possessions in India and Africa, French Somaliland, Turkey in Asia, Java, Venezuela, Ecuador, Peru, Liberia, Chile, Panama, East Africa Protectorate, Uganda, Nyasaland, and British West Indies, to a total in 1913 of 948,047 centals.

1. 1891, "Artificial Coffee Beans," pp. 201-204; 1894, "Coffee Cultivation in Angola," pp. 161-163; "Maragogipe Coffee," pp. 163-164.

1a. ix. 3 (1915), "*Coffea*," pp. 361-373.

"African" or "Negro Peach" (*Sarcocephalus esculentus*, Afzel.), a tree or shrub of West Africa has an edible fruit eaten by the natives.

Compositae.

Helianthus annuus, *Linn.*; Sunflower.

Annual, varying according to variety from about 3 to 10 ft. in height, native probably of North America, common in Mexico, extending to Peru, and under cultivation in many tropical and sub-tropical countries. "American Giant," "White Russian," "Large Russian," &c., are strains commonly grown for seed.

The seeds are used for feeding poultry, and in Russia by the inhabitants there they are eaten like nuts; roasted and ground they are sometimes used as a substitute for coffee. They yield an oil suitable for culinary and table purposes, in the manufacture of margarine, and said to be equal to olive or almond oil, for which it is sometimes substituted. The residue, after the extraction of the oil, is pressed into cakes and used for feeding cattle—for which purpose it is considered advisable to grind it into as fine a meal as possible to admit of easier digestion, this cake being harder than most oil cakes, and almost impossible for cattle to chew in large pieces. The leaves mixed with bran are considered good fodder for cattle and horses. Sometimes sunflowers are grown thickly and cut for fodder, but the woody nature of the plant makes them undesirable for this purpose (Piper).

Helianthus tuberosus, *Linn.*; Artichoke, Jerusalem Artichoke.

Herbaceous perennial, stems 6 to 10 ft. high, native of North America; introduced to Europe, Asia, Africa, &c.; cultivated generally for the tuberous roots as a vegetable and sometimes used as food for stock. "Helianthi" is a closely allied plant that has been advised as equal, if not superior, to the Jerusalem Artichoke; but experiments go to show that it is less valuable as a forage crop.

1a. ix. 3 (1915), "*Helianthus*," pp. 385-389.

2. Sept. 1894, "Sunflower Seed Cake," pp. 72-73; Aug. 1908, "Sunflower Seed," pp. 369-370; Feb. 1912, "Jerusalem Artichokes as Food for Stock," pp. 926-931; Feb. 1912, "Helianthi as a Food for Stock," pp. 937-938; April, 1918, "Jerusalem Artichokes," pp. 84-85.

Cichorium Intybus, *Linn.*; Chicory, Succory.

Perennial, with a tuberous root. Europe, where, including

England, it is wild and cultivated. Raw or kiln-dried chicory is imported chiefly from Belgium (96136 out of a total of 96,804 centals in 1913), and since in lesser quantity from that country and in improved quantities from Denmark, France, Holland, Portugal, and United States. Roasted or Ground Chicory also came in from these countries, and also from Union of South Africa (80) to a total of 1491 centals in 1913. Chicory—root roasted and ground—is well known as a mixture with coffee; the blanched leaves may be used as a salad, and the plant is grown for forage, cattle, horses and sheep feeding freely upon it. Dried Chicory roots have also been recommended for feeding horses as a substitute for oats—"Chicory Crumbs" up to 10 lb. per day (Commerce Rep. Washington, No. 156, 1915; pp. 74-75).

2. Aug. 1904, "The Chicory Industry of Great Britain," pp. 268-271; Feb. 1915, "The Cultivation of Chicory," pp. 1019-1025.

Achillea millefolium, *Linn.*; Yarrow, Milfoil.

Herbaceous perennial, 2 to 3 ft. high, a common wild plant in Northern Europe, including Britain, in North Asia, and North America, adapted to poor dry soil and recommended in permanent pastures, especially for sheep.

Lactuca sativa, *Linn.*; Lettuce.

Annual, cultivated in many temperate countries and some hot countries, including India, Cuba, Africa, West Indies, &c., as a salad. Lettuces are imported into the United Kingdom from France and the Canary Islands in the early months of the year, before the home supplies become plentiful.

1a. ix. 3 (1915) pp. 395-396.

Carthamus tinctorius, *Linn.*; Safflower.

Annual, about 3 ft., including spiny and spineless forms, probably native of Egypt; cultivated in the Sudan, Senaar, Abyssinia, India, China, South Europe, &c., chiefly for the dye from the florets and oil from the seeds; known in commerce as "Kurdee." The seeds are edible, especially after roasting, and are also good food for poultry. The oil expressed from the seeds, in addition to various industrial uses, may be used for culinary purposes, and the residual cake is a good cattle food. The young plants of the spineless forms may be used as fodder, and as a vegetable or pot-herb.

1a. 3 (1915), pp. 392-395.

The Order also includes "Niger" or "Ramtil" (*Guizotia abyssinica*, Cass.) of Tropical Africa, cultivated in India, oil from the seed used for culinary purposes; "Endive" (*Cichorium Endivia*, Linn.), a hardy annual commonly grown as a salad; "Cardoon" (*Cynara Cardunculus*, Linn.), a hardy perennial, blanched stalks of the inner leaves used in salads, &c.; the "Globe Artichoke" (*Cynara Scolymus*, Linn.), a hardy perennial, cultivated as a vegetable, "Scorzonera" (*Scorzonera hispanica*, Linn.), native of Spain, roots used as a vegetable; "Salsafy" (*Tragopogon porrifolius*, Linn.), cultivated as a

vegetable and "Wormwood" (*Artemisia maritima*, Linn.), abundant in the Western Himalayas, near the Caspian and Black Seas, in the Salt Plains of Western Tibet and in countries bordering the Mediterranean—fed upon by ponies in the Himalayas and suggested as a fodder plant where other vegetation is scarce (*K.B.* 1893, pp. 126-128).

VACCINIACEAE.

Oxycoccus palustris, *Pers.*; Common Cranberry. **O. macrocarpus,** *Pers.*; American Cranberry.

Small shrubby plants with creeping slender stems, found in boggy land, the former indigenous to Britain and alpine parts of Europe, Siberia and North America, and the latter native of North America, from Canada to Virginia.

Fruits of both are edible and commonly made into jam and jelly; those of *macrocarpus* are imported into the United Kingdom, exported from Nova Scotia, &c.

Vaccinium myrtillus, *Linn.*; Whortleberry, Bilberry. **V. Vitis-Idaea,** *Linn.*; Cowberry—small shrubs a foot or so high, native of Britain, and **V. corymbosum,** *Linn.*; Swamp Blueberry—a shrub about 7 ft. high, native of North America, where it is also cultivated. All the species in their wild state favour moist alpine or sub-alpine situations, and fruits of all are edible. In Britain those of the native species are collected about July and August for making into jam, jelly, &c., and moor game in autumn feed largely upon the fruits.

V. canadense, Kalm, and *V. pennsylvanicum*, Lam., are also known as "Blueberry" in Canada, where they are gathered for sale by settlers and Indians (*K.B.* Nov. 1887, p. 17). *V. Arctostaphylos*, Linn., is used in the Caucasus as a substitute for tea (*K.B.* 1895, pp. 61-63).

In the closely allied Order **Ericaceae** there is little of importance, but the following may be mentioned:—The "Strawberry Tree" (*Arbutus Unedo*, Linn.), fruits collected and eaten by the peasantry in Ireland (Johnson & Sowerby), "Bearberry" (*Arctostaphylos Uva-Ursi*, Spreng.), a trailing shrub of the Highlands of Scotland, fruits commonly eaten by grouse, *Gaultheria Shallon*, Pers., fruits eaten in Vancouver Island; "Winter Green" or "Partridge Berry" (*Gaultheria procumbens*, Linn.), of North America, the leaves called "Mountain" or "Salvador" Tea, used as a substitute for China Tea, "Labrador Tea" (*Ledum palustre*, Linn.), and "Heather" or "Ling" (*Calluna vulgaris*, Salisb.), which covers large areas (3,901,713 acres in England and Wales of Mountain and Heathland used for grazing, estimated in 1917), an important bee flower, "Heather Honey" being one of the standard kinds of commerce; the leaves, flowers, seeds and fine stalks of heather ground into meal are recommended for feeding poultry (*see* Journ. Bd. Agric. May, 1918, p. 185 and Leaflet No. 114), and grouse feed on the young shoots.

SAPOTACEAE.

Achras Sapota, *Linn.*; Sapodilla, Sapodilla Plum, Naseberry Milk Apple, Gum Chicle Tree.

A tree, 30 to 40 ft. high, native of the West Indies and Mexico; cultivated in many warm countries, including Central America, West Indies, British Guiana, India, Philippine Islands, Straits Settlements, West Africa, &c. The fruit is edible, described as one of the most delicately flavoured and wholesome fruits grown. It is said to stand transport well, but does not appear to come into the English market—fruits have been found to carry well from Demerara (*K.B.* 1888, p. 179). An extract known as "Chicle Gum" or "Sapodilla Gum" is obtained from the tree, which is an important article of commerce with America, where it is used in the manufacture of chewing gum.

1a. ix. 3 (1915), pp. 400-402.

Butyrospermum Parkii, *Kotschy*; Shea Butter, Beurre de Karité.

A tree 30 to 40 ft. high with a trunk 5 to 6 ft. in diam., native of West Africa, principally Nigeria. The kernels yield about 50 per cent. of fat known in commerce as "Shea Butter" as exported from the Niger, and the oil extracted from the kernels in England is known as "Shea Nut Oil." Used by the natives for food and in Europe for the manufacture of substitutes for butter in addition to other industrial uses. The total of Shea products exported from Lagos in 1913 was 2069 centals —1902 of which came to the United Kingdom, the remainder to countries not specified. The supplies are probably all from wild sources; there is a plantation at Oloke-meji in Nigeria and seeds and plants have been sent out from Kew to various Colonies; but the only definite information of success in growing the tree to maturity in countries outside of Africa comes from Dominica, where a tree sent out from Kew in 1899 was reported (1913) as a healthy plant 40 ft. in height, flowering freely but fruiting sparsely; fruits from this tree have recently (Sept. 1918) been received at Kew.

1. 1899, "Karité Tree," pp. 53-55.

1a. ix. 3 (1915), pp. 410-415.

The following have edible fruits:—"Star Apple" (*Chrysophyllum Cainito*, Linn.), "Marmalade Plum" (*Lucuma mammosa*, Gaertn.), trees native of the West Indies and South America; and "Miraculous Fruits" (*Synsepalum dulcificum*, Daniell), of West Africa—the fruits impart a sweet taste to anything bitter, sour or acid in character, used by the natives to sweeten palm-wine (*K.B.* 1906, p. 171). "Mahwa" (*Bassia latifolia*, Roxb.), and "Mee" or "Illipi" (*B. longifolia*, Linn.) of India yield an oil from the seeds used for culinary purposes in India, where the flowers of the trees are also eaten. The "Butter Tree" (*B. butyracea*, Roxb), of India, yields an oil or fat used for cooking or as an adulterant of "Ghee." The residual cake after the expression of the oil of these Bassias is

unfit for feeding purposes, being more or less poisonous. *Pouteria suavis*, Hemsl., of Uruguay, has edible fruits (*K.B.* 1906, pp. 365-366).

Ebenaceae.

Diospyros Kaki, *Linn.*; Persimmon.

A tree 30 to 40 ft. high, native of Japan; cultivated in France, India, America, Philippines, China, &c.

There are upwards of 100 varieties, of which there is a good range of specimen fruits (50 varieties) in the Museum at Kew. "In Central and Northern Japan the variety which produces large orange-coloured ovate thick-skinned fruit is the only one planted, and the cultivation of the red-fruited varieties is confined to the south." "The orange-coloured variety, fresh and dried, is consumed in immense quantities by the Japanese, who eat it as they do all their fruits, before it is ripe, and while it has the texture and consistency of a paving stone." (Sargent. For. Fl. Japan, p. 50). *Diospyros Roxburghii*, Carr. is the "Persimmon" of Western China and Eastern India.

1. 1911, "Persimmons," pp. 234-245.

"Monkey Guava" or "Zanzibar Ebony" (*D. mespiliformis*, Hochst.), a shrub or tree 10 to 40 ft. high, of Tropical Africa, has an edible fruit.

It may be noted that some of the fruits of *Diospyros* are poisonous, as, for instance, *D. Ebenaster*, Retz., with large globose fruits, 3 in. in diam., olive or yellowish-green coloured (*K.B.*, 1915, p. 67), and to all outward appearances a "Kaki" fruit. It is pounded and thrown into rivers to stupefy fish, in order to catch them for food, in the West Indies.

Oleaceae.

Olea europaea, *Linn.*; Olive.

A tree, native of Syria and Greece; cultivated in the Mediterranean region, extending from Southern Spain to Southern Russia, and also in California and Australia.

The oil obtained from the pulp of the fruit is well known as a salad oil, and it is also used in the tinning of sardines; the fresh fruits are used for dessert. The imports of olive oil into the United Kingdom in 1913 were for "Refined," 6,163 tuns from France, Spain, Italy, Greece, Turkey, and Crete, and of "Unrefined," 2,882 tuns, from the same countries, including the Netherlands.

Boraginaceae.

Symphytum asperrimum, *Donn,*; Forage Comfrey, Prickly Comfrey.

Perennial, 4 ft. high, native of the Caucasus, grown as a forage plant in Europe, including England (where it was introduced more than a century ago), and in America, recommended as a soiling crop for pigs, sheep, and cows.

CONVOLVULACEAE.

Ipomoea Batatas, *Lam.*; Sweet Potato, Spanish Potato.

A perennial plant with a tuberous root and vine-like stems; cultivated throughout the Tropics of the Old and New Worlds and in many sub-tropical countries under upwards of 50 varieties. The roots or tubers are used for food in much the same way as those of the common potato; they are also fed to animals, but owing to the high percentage of starch they are recommended to be mixed with some fodder of greater nitrogenous value, as "Pea Nuts" (*Arachis hypogaea*) and other fodders in *Leguminosae* (see p. 7) Cotton-seed meal or grain to form a suitable ration. The stems and leaves (or vines) are good fodder, green or dried, for cattle, sheep, and pigs. There is a small trade between Barbados and this country and between Algiers and Paris, in the tubers, and in 1913, 3,360 centals of starch obtained from the tubers of this plant were imported into the United Kingdom from Natal.

The stems and leaves of *Ipomoea digitata*, Linn. of Tropical Africa, India, &c., are used as fodder for cattle in India (Watt).

1a. ix. 3 (1915) pp. 475-479.

SOLANACEAE.

Lycopersicum esculentum, *Mill.*; Tomato.

Cultivated in most warm countries for the fruit. Tomato-growing is an important industry in Italy, Sicily, United States, Mexico, West Indies, Egypt, Canary Islands, &c. It is estimated that in Italy, in the Province of Parma chiefly, there are 1,881,600 centals preserved annually for food—the skins being used for feeding stock—and Italian Tomato Paste is largely imported into the United States. Approximately 10,000,000 cases annually are turned out from the canning factories of the United States, and shipments of ripe tomatoes from the Gulf Coast region of Mexico are made in large quantities to the markets of that country. In the United Kingdom the imports of fresh fruit in 1913, chiefly from Channel Islands, Canary Islands, Spain, Holland, France, Portugal, and Italy, amounted to 1,772,944 centals, and there is also a large trade in home produce, grown under glass chiefly, and also out of doors.

1a. ix. 3 (1915) pp. 480-482.

Solanum tuberosum, *Linn.*; Potato.

An annual plant, native of Chile, but spread by cultivation over nearly the whole world—warm, temperate, sub-tropical, and tropical. Used chiefly as a vegetable, but the production of dried potatoes, starch, and flour, are important industries. Potatoes are imported on a large scale from Holland (3169685), Germany (2586144), France (1708157), Belgium (1122276), Channel Islands (1233060), Spain (244186), Canary Islands, Portugal, Norway, Denmark, Algeria, Malta, and Gozo, to a total of 10,558,594 centals. The home production in the same year amounted to 170,347,609 centals, under an acreage of 1,173,418. 546,769 centals of potatoes were exported from the United Kingdom, and 1,010,104 centals of "Farina" or

"Potato Starch" were imported, chiefly from Central Europe and the United States.

1a. ix. 3 (1915), pp. 485-487.

2. Numerous notes and papers.

3. No. 173, 1918, "Potato Growing"; No. 296, 1918, "Potato Growing in Allotments and Small Gardens" No. 299, 1917, "Storage of Potatoes and other Vegetables for Winter Use."

3a. No. 67, 1916, "Economy in Using Potatoes"; No. 69, 1917, "The Culture of Early Potatoes under Glass"; No. 74, 1917, "Cutting of Seed Potatoes."

The "Garden Egg," "Egg Plant" or "Brinjal" (*Solanum Melongena*, Linn.), a shrubby spiny plant 3 to 4 ft. high, is commonly grown as a vegetable in most warm countries, including China, India, West Indies, Tropical Africa, Southern Europe, &c. "Melon Pear" or "Pepino" (*S. muricatum*, Ait.), of Peru, has an edible fruit. It has been tried at Kew and in the gardens of the Royal Horticultural Society; but the fruits grown under glass have been found to be decidedly inferior to those grown in its native country, and quite unsuitable as a dessert fruit here (*K.B.* 1893, p. 21).

Capsicum annuum, *Linn.*; Capsicum, Red Pepper.
An annual, widely distributed in the Tropics.

Capsicum frutescens, *Linn.*; Capsicum, Chillies, Bird Pepper.
A small shrub, common throughout all tropical countries.

The Capsicums generally are used chiefly as condiments, "Cayenne Pepper" being made from the more pungent kinds, and the milder fruits as a vegetable, stuffed with meat and baked, or eaten raw as a salad. An extensive trade is done in the fruits under the name "Capsicums" and "Chillies," the former being broadly used for the larger fruits and the latter for the smaller. The principal sources of supply are Zanzibar, Uganda, Nyasaland, British East Africa, Sierra Leone, Natal, India, Japan and the West Indies, the total trade approximating to 100 tons a year (*see* Returns under *Piper nigrum* from Japan. British East Africa, and other British Possessions: probably all "Capsicums").

1. 1898, "Chillies," pp. 171-175.

1a. ix. 3 (1915), "*Capsicum*," pp. 489-492.

The "Cape Gooseberry" (*Physalis peruviana*, Linn.), a shrubby plant 2 to 3 ft. high, native of Peru, widely distributed in the Tropics; makes a good preserve. The "Tree Tomato" (*Cyphomandra betacea*, Sendt.), a shrub or small tree, 8 to 12 ft. high, native of Peru, cultivated in East Africa, West Indies, Southern Europe, &c., has an edible fruit which may be eaten raw or cooked like the ordinary tomato, and makes a good preserve and jelly.

1. Aug. 1887, "Tree Tomato," pp. 2-6.

1a. ix. 3 (1915), "*Physalis*," pp. 487-488; "*Cyphomandra*," pp. 488-489.

PEDALIACEAE.

Sesamum indicum, *Linn.*; Sesame, Gingelly or Gingili (India), Til (Bengal), Benniseed (Sierra Leone), Sim-sim (Sudan, E. Africa), Goma (Japan).

Annual, believed to be a native of Tropical Africa; widely spread by cultivation in the Tropics and Sub-tropics. The chief use of the plant is in the production of oil from the seed—black and white, the best quality oil being obtained from the white seed—used everywhere as food and as a substitute for olive oil. The seeds are made into sweetmeats and toasted and ground they are made into cakes, and they have also been submitted to Kew for identification with the statement "found in raspberry jam." The cake made from the residue after the extraction of the oil is an important cattle food. Cases of poisoning have been known to occur, believed to be due to the presence of soluble oxalates or free oxalic acid in the seed.

There is a large trade in the seed in Europe, of which Marseilles is perhaps the most important centre, with India, China, and Africa the main sources of supply. The Customs Returns were included in "Seeds unenumerated" prior to 1917, in which year the amount imported into the United Kingdom was 115,404 quarters chiefly from British India (92,778 qrs.), China (13,120 qrs.), Nigeria (7,587 qrs), and the remainder from other foreign countries and British Possessions not enumerated.

The seeds of *Ceratotheca sesamoides*, Endl., are eaten like those of *Sesamum* in Uganda.

Ia. ix. 3 (1915), pp. 511-514.

LABIATEAE.

Coleus rotundifolius, *A. Chev.*; Madagascar Potato, Hausa Potato, Salaga (Togoland) Potato, Fra-Fra (Gold Coast) Potato.

Perennial, 1 ft. high, cultivated in many parts of Tropical Africa and in Java, Ceylon, Mauritius, Madagascar, &c., for the tubers, used as food, like the ordinary potato.

Ia. ix. 3 (1915), pp. 531-533.

The "Umbondive" or "Kaffir Potato" (*Plectranthus esculentus*, N. E. Br.), is a favourite food of the natives in Natal, and "Risga" (Hausa) (*Plectranthus floribundus*, N. E. Br., var. *longipes*) is cultivated in Nigeria for the tuberous root-stocks, used as food, and they are also so used in Southern Rhodesia. "Benefing" (*Hyptis spicigera*, Lam.), an annual, 5 ft. high, of French West Africa, is cultivated and used for food in much the same way as *Sesamum indicum* in British West Africa, Uganda, Nile region, &c. The tubers of "Crosnes" or "Chinese Artichoke" (*Stachys Sieboldii*, Miq.), are used for food in China and Japan, where the plant is cultivated for the purpose; introduced into Britain as a new esculent in 1885, and also cultivated in France for the Paris markets. The well-known culinary herbs "Thyme" (*Thymus vulgaris*, Linn.), "Marjoram" or "Sweet Marjoram" (*Origanum Marjorana*, Linn.), and "Mint" (*Mentha viridis*, Linn.), also belong to this Order. (*K.B.*, 1916, "Culinary Herbs," pp. 202-203.)

AMARANTACEAE.

Amaranthus caudatus, *Linn.*; Love-lies-bleeding, Ramdana (India).

Annual, 1 to 3 ft. high, cultivated in India for the seed used as food (Watt), and in Tropical Africa the plant is cultivated for use as spinach (Chevalier, Bull. Soc. Nat. d'Accl. 1912, reprint p. 30).

Amaranthus paniculatus, *Linn.*; Common Amaranth.

Annual, 2 to 3 ft., native of Tropical Africa, India, &c. The grain is one of the most important sources of food with the hill tribes in India (Watt); leaves and shoots used for salad in West Africa.

Amaranthus polygamus, *Linn.*; an annual plant, is cultivated throughout India and all over the southern parts of Asia as a pot-herb (Watt), and other species might be mentioned for use in the same way.

CHENOPODIACEAE.

Atriplex semibaccata, *R. Br.*; Salt Bush, Half-berried Salt Bush.

A perennial spreading herb, 1 to 2 ft. high, native of Australia; cultivated in California on alkali lands for forage, also cultivated experimentally in Antigua. It is a "plant held in much esteem by stock owners as a most valuable herb for sheep, which eat it down with avidity" (Turner).

"Slender Salt Bush" (*A. leptocarpa*, F. Muell.), of Australia has also been introduced to California. *Atriplex halimoides*, Lindl., of Australia; "Garden Orache" or "Mountain Spinach" (*A. hortensis*, Linn.), of Northern Asia—a favourite vegetable in India and much cultivated in France for its large succulent leaves and as spinach and "Cape Salt Bush" (*A. Halimus*, Linn.), of Southern Europe and the Mediterranean region, are grown at Kew as ornamental plants. The last-mentioned is grown in the Isle of Wight and elsewhere near the sea as a hedge plant; but none appear to have been grown in England for forage.

Chenopodium Quinoa, *Willd.*; Quinoa.

Annual, 3 to 5 ft., native of the Andes of Chile, Peru and Bolivia, where it is an important article of food of the inhabitants, principally Indians of the labouring class. The plant has been introduced to India from Peru, but so far with comparatively little success. The plant flourishes at high altitudes (there is a good set of specimens of seeds from Lake Titicaca, Bolivia, altitude 12-13,000 ft., in the Kew Museum) where the climate is more or less temperate. It has been suggested as a food crop in England; but although it has been grown on a small scale to maturity at Kew, it is probable that no advantage would be gained by cultivating it on a large scale. The seeds are very small (about 15,000 to the ounce) and might for value as a

food be considered parallel with those of *Digitaria Iburu* in Nigeria and *Eleusine coracana* in India (see under *Gramineae*), with a people amongst whom the trouble of preparation can only be appreciated because the material and labour are plentiful and cheap.

"Blue Bush" (*Chenopodium auricomum*, Lindl.), a plant 5 ft. high and upwards is a superior pasture plant "which stock of all kinds are remarkably fond of" (Turner), and the succulent stems and leaves are an excellent table vegetable when cooked as Spinach (Maiden). The "Goosefoot Salt Bush" (*C. atriplicinum*, F. Muell.), a foot or so high, "forms a dense mass of nutritious succulent herbage" and the "Nitre Bush" (*C. nitrariaceum*, F. Muell.), a branching undershrub from 3 to 4 ft. in height (8 ft. under cultivation) of which it is stated "sheep in eating this bush often trim it as neatly as if it had been clipped with handshears" (Turner), are all natives of Australia. It may be mentioned here that there are other species of this genus and of *Kochia* and *Rhagodia* that are known as "Salt Bushes," more or less valuable for forage, included in the Order. "White Goose Foot" (*C. album*, Linn.), a common weed in Britain, on the Continent and in Temperate Asia, is cultivated as a food grain, pot-herb and vegetable in India (Watt). "Australian Spinach" (*C. murale*, Linn.), of the southern colonies, Australia, is used as a pot-herb (Maiden). "Uauhtzontli" (*C. Nuttalliae*, Safford), is cultivated as a food plant by the Aztecs in Mexico (Safford, Journ. Washington Acad. Sci. viii. Sept. 1918, pp. 521-527).

1. 1896, "Sheep Bushes and Salt Bushes," pp. 129-140; 1897, "Fat Hen in Australia (*Chenopodium album*)," pp. 218-219; 1909, "Australian Salt Bushes," pp. 30-32; 1909, "Quinoa," pp. 425-427.

Beta vulgaris, *Linn.*; Beetroot, Sugar Beet, Mangold or Mangel, Mangold Wurzel.

Biennial plants, usually cultivated as annuals, native of the shores of the Mediterranean and of the western coasts of Europe. The Sugar Beet includes the white varieties "blanche à sucre améliorée" (Vilmorin) and "blanche à sucre Klein-Wanzleben" (Vilmorin), grown largely in Europe and America for the production of sugar. When Achard initiated the manufacture of sugar from beetroot the white field variety was judged the most suitable; it contained from 8 to 10 per cent. of its weight in pure sugar; selection in the course of the next 50 years raised the percentage of sugar to 12 or 13 per cent. (of the gross weight of the root), and after 1850 a race was established by Vilmorin yielding 16 and even 18 per cent. of sugar, beyond which it is stated beetroots cease to vegetate properly and die. (*K.B.* 1897, p. 317.) The amount of unrefined beetroot sugar imported in 1913 was 15,267,165 cwts., chiefly from Austria-Hungary (3603733), Denmark (704475), Germany, Holland, Belgium, and France (no returns given 1913). Experiments in growing Sugar Beet in England, more particularly Norfolk, have been made in conjunction with factories in Holland, and

the results go to show that the plant can be grown very successfully. (See Journ. Bd. Agric., June, 1911, and March, 1916, "Progress of the Sugar Beet Industry in Norfolk").

Syrup is also made from the root (a description of a simple process of making syrup is given in Journ. Bd. Agric., Dec., 1917, p. 1002). In the process of preparation for sugar the leaves and crowns may be fed to stock, used in the fresh stage, dried or as ensilage, and the pulp residue is also good fodder.

The Mangold is an important field crop at home, especially in the Southern and Midland Counties, on the Continent, and in America, under varieties broadly divided as white, yellow, and red-fleshed, including "globe," "tankard," and "long" forms; especially valuable as a winter feed for dairy cows and sheep. In 1913—207,785,289 centals were produced from 500,209 acres in the United Kingdom, England alone producing 166,532,150 centals of the whole amount of roots under an acreage of 409,150.

The "Red Beet" is well known in gardens everywhere as a vegetable, and the "Silver Beet" (*B. vulgaris*, var. *Cicla*) is grown for the leaf used as a vegetable, more especially in France.

"Spinach" (*Spinacea oleracea*, Linn.) is well known as a vegetable, and *Basella alba*, Linn., is cultivated in India, Africa, and West Indies, for use in the same way.

2. Numerous papers on Sugar Beet and Mangold.

3. No. 169, 1912, "Cultivation of Mangolds."

Polygonaceae.

Fagopyrum esculentum, *Moench.* (*Polygonum Fagopyrum*, Linn.), Buckwheat, Brank.

Annual, 3 ft., of which there are many cultivated varieties grown in Europe, Asia, China, India, &c., and in North America. Three varieties, "Japanese," "Silver Hull," and "Common Gray" are grown in the United States (Carleton). In Britain the plant is grown only to a limited extent, and chiefly on waste land. The grain is an important food in America, China, India, &c., and it is also largely used for feeding poultry and game. The green plant is used in America for forage; but it is said to be "sometimes injurious to sheep" (Farmer's Bull. U.S. Dept. Agric., No. 267, 1906, p. 13), or "to have a narcotic effect on sheep" (Johnson and Sowerby). The ground grain is used as a feed for hogs (Carleton). The flowers are a good bee food, and it is reported that in the Government of Tchernigov, Russia, it is the principal source of honey (Journ. Bd. Agric., June, 1895, p. 2).

The supply of buckwheat to the United Kingdom comes chiefly from Russia (43232), France (19062), United States (6854), and other Foreign Countries and British Colonies not specified, to a total (1913) of 78,046 centals.

"Tartarian Buckwheat" (*Fagopyrum tartaricum*, Gaertn.) is grown in the colder parts of North America and Asia—in Ladak, Zanskar, and Western Tibet. Leaves much used as a pot-herb in summer, when other green food is not easily

obtained (*K.B.*, 1893, p. 1). The var. *himalaica* is the "Kangra Buckwheat."

1. 1891, "Kangra Buckwheat," pp. 244-245; 1893, *ibid.*, pp. 1-3, "Common Buckwheat," p. 3.

2. Feb. 1916, "The Cultivation of Buckwheat," pp. 1128-1134; April, 1918, *ibid.*, pp. 81-84.

3a. Food Production, No. 42, 1918, *ibid.*

Polygonum sachalinense, *F. Schmidt*; Sachaline.

Perennial, 6 to 10 ft. high, native of Japan and Island of Sachalin. A forage plant suitable as green feed for all kinds of stock. The plant yields 8 to 16 tons per acre, but in America possesses no advantage over Corn (Maize) or Sorghum. Sachaline was tested at many of the American experiment stations, but has not commended itself as worthy of culture except as an ornamental (Piper). The plant grows freely at Kew.

"Redshank" (*P. Persicaria*, Linn.), a common weed in Britain, is stated to be a nutritious plant, fed green to horses and cattle (Journ. Bd. Agric. July, 1918, "Weeds as Food," p. 384). "Rhubarb" (*Rheum Rhaponticum*, Linn.), a native of Southern Siberia, is well-known for the acid leaf-stalk. "Phog" (*Calligonum polygonoides*, Linn.), a small, densely branched shrub, 3 to 4 ft. high, of India, Persia, Arabia, Syria, Armenia, Egypt, Algeria, and the Canaries, is remarkable for the use of the flowers as food; they are succulent and are an important article of food in many parts of India; eaten raw or cooked, often with parched grain, and put into sweetmeats (*K.B.* 1889, pp. 217-221).

Piperaceae.

Piper nigrum, *Linn.*; Pepper.

A woody climber, native of Malabar; cultivated in Malay Peninsula, Southern India, Borneo, Siam and other tropical regions for the berries or "Peppercorns," well known as a spice. "Black Pepper" is the dried unripe berries and "White Pepper" the ripe fruit with the outer coating removed before grinding. The Customs Returns under "Pepper" probably also include "Red Pepper" or "Capsicum," the sources given being Straits Settlements, including Labuan (54075), Java (29555), British India (13870), Siam (12745), French Indo-China (8890), Ceylon (1475), [British East Africa (1148), Japan (958), British Possessions not enumerated (2070), probably all Capsicum], Germany, Holland, France and foreign countries not enumerated, to a total of 131,767 centals.

1. 1893, "Pepper in Siam," p. 230.

Myristicaceae.

Myristica fragrans, *Houtt.*; Nutmeg.

A bushy tree 30 to 40 ft. high, native of the Moluccas or Spice Islands of Banda; cultivated in Malaya, Java, West Indies; introduced to Ceylon, Mauritius, South America, West Africa, Zanzibar, and other tropical countries, but there is no production of importance excepting perhaps in the West Indies.

The Banda Islands are the most important trade source of Nutmegs. The "mace" (or the "Arillus," which when fresh is bright red) is also imported as a spice.

Laurineae.

Persea gratissima, *Gaertn.*; Avocado Pear.

A tree, 20 to 30 ft. high, commonly cultivated in the Tropics for the fruit. A trade under cold storage from Dominica was suggested in 1888 (*K.B.*, p. 209) and two consignments from the Bahamas to New York and London (1910) carried with a loss of only 2·9 per cent. (Bull. Dept. Agric. Bahamas, Sept., 1910). The fruit comes occasionally into Covent Garden market and fruits have been noted in Liverpool shops (*K.B.*, 1908, p. 189). Avocado Pears are exported from Hawaii to the United States, and it is reported that shipments arrive at Chicago in very good condition.

Cinnamomum zeylanicum, *Breyn.*; Cinnamon.

A tree 20 to 40 ft., native of Ceylon, where under cultivation the greater amount of bark is produced. Grown to a smaller extent in India, Java, Seychelles, and French Guiana. The bark, used chiefly as a spice, is imported from Ceylon (6359), Seychelles (1008), British Possessions, not enumerated (7910), and foreign countries, not enumerated (174), in 1913.

"Bay Laurel" or "Sweet Bay" (*Laurus nobilis*, Linn.) leaves are used in cookery; they are often confounded with those of the "Common Laurel," "Cherry Laurel" or "Magnolia-leaved Laurel" (*Prunus Laurocerasus*, Linn.), which, although sometimes used for flavouring in the same way, are known to contain hydrocyanic acid and to produce injurious and even fatal results, and their use should not be permitted. It is only the "Sweet Bay" leaf that is safe to use.

Euphorbiaceae.

Manihot utilissima, *Pohl*; Cassava, Mandioca, Tapioca.

A shrub, 6 to 10 ft. high; but varying according to variety, of which there are many from about 3 ft. to the maximum height. Native of Brazil; cultivated more or less throughout Tropical America, Asia and Africa. The flour or starch obtained from the large tuberous roots is everywhere an important food. The flour has somewhat the appearance of coarse oatmeal, and "Tapioca," the preparation best known in this country, is a pure form of starch which settles from the water in washing the Cassava meal, and afterwards granulated on hot plates. "Mandioca" or "Tapioca" flour is imported from Holland, Java, Brazil and Straits Settlements—720,509 centals in all for 1913, and "Cassava Powder" and "Tapioca" imports in the same year came from the same sources to a total of 325,005 centals.

Two important variations exist in the roots usually distinguished as "Sweet" (sometimes called *M. palmata*, var. *Aipi*) and "Bitter" Cassava (*M. utilissima*). The last-mentioned is found to be more or less poisonous, due to prussic acid content,

and it is essential to have the poisonous juice separated by grating, washing and cooking before being eaten. From this same juice, however, the product known as "Cassareep" by boiling down is obtained. It is largely used in the West Indies for culinary purposes, and in this country for the preparation of various table sauces.

The "Herbert River" or "Queensland Cherry" (*Antidesma dallachyanum*, Baill.), a shrub or small tree, has an edible fruit said to be equal to that of the "Red Currant" (*Ribes rubrum*) when made into jelly (*K.B.* 1895, p. 272). The fruits of *Antidesma Bunias*, Spr., are used for preserving and the acid fruits of the "Otaheite Gooseberry" (*Phyllanthus distichus*, Muell. Arg.), are used for pickling in Java, where also the fruits of *Baccaurea racemosa*, Muell. Arg., are eaten. The "Emblic Myrobalan" (*Phyllanthus Emblica*, Linn.), a small tree of India and Burma, and "Rambeh" (*Baccaurea dulcis*, Muell. Arg.), have edible fruits. The seeds of "Jamaica Cob Nut" or "Hog Nut" (*Omphalea triandra*, Linn.), a small tree of the West Indies, are eaten raw or roasted.

Urticaceae.

Humulus Lupulus, *Linn.*; Hop.

A twining perennial plant, native of Europe, Caucasus, Central Asia, &c., and found wild in England; cultivated in Belgium, Bavaria, Russia, United States, &c. The female flowering cones ("catkins" or "strobiles") known as "hops" are used in brewing beer. The young shoots, when about 4 to 5 in. long, thinned from the plants are used as a vegetable in Belgium and are recommended for a similar use in this country, the thinnings from the hop-fields at the time the plants are starting into growth, are estimated at about 70 lb. per acre (Journ. Bd. Agric., Jan., 1910, p. 581). "Hops" in 1913 were imported from United States, Germany, Belgium, Canada, Holland, Russia, Austria-Hungary, France, New Zealand, Australia, and Mexico, to the amount of 293,646 centals. In the same year the home production was 286,318 centals from 35,676 acres in the counties of Kent, Hants, Hereford, Surrey, Sussex, Worcester, and to the least extent in Gloucestershire, Salop, and Staffordshire.

2. Numerous references.

Cannabis sativa, *Linn.*; Hemp.

Annual, 4 to 8 ft., native of the temperate parts of Asia, near the Caspian Sea, Persia, &c.; cultivated in Europe, India, America, Siberia, &c. The seed produced in most of the countries mentioned above, where the plant is grown for fibre, is well known for feeding birds, and the oil extracted by cold pressure is used for cooking, and the oil-cake is an important food for stock.

Morus alba, *Linn.*; White Mulberry.

A small deciduous tree, native of Northern and Western Asia, cultivated in Northern India, China, Japan, and Southern

Europe for its leaves—showing a great variety—used for feeding silkworms. The fruit is edible.

Morus nigra, *Linn.*; Black Mulberry.

A deciduous tree, about 30 ft. high, believed to be a native of Persia, the Caucasus and Armenia, and occurring apparently wild in Italy, Sicily and Greece. Cultivated in Northern India and the Nilgiris for purposes of sericulture (Watt). Fruit edible but subject to decay quickly, well-known as a dessert fruit and may be made into preserve.

Ficus Carica, *Linn.*; Fig.

A small tree or straggling bush, native of Syria and Asia Minor; cultivated in Southern Europe, to some extent in the south of England, in Western Asia and the United States.

Preserved figs and "fig cake" are imported from Asiatic Turkey, Portugal, Spain, France, Algeria, Greece and United States, the amount in 1913 being 180,579 centals. The largest and best figs are those of Smyrna or Turkey.

The "Sycamore Fig" or "Fig of Pharoah" (*Ficus Sycomorus*, Linn.), a large tree of Egypt, has an edible fruit, which, though not so fine as the above, is said to be very agreeable and apparently much used by the Arabs.

Artocarpus incisa, *Linn.*; Bread Fruit, Bread Nut.

A large tree, native of the South Sea Islands, where the fruit is a staple food. Introduced to other tropical countries, including Asia, Africa, America, West Indies, &c. The story of Capt. Bligh and the introduction (in 1793) of plants to the West Indies is familiar to all. There are two forms of the tree, one with seedless fruit and one with seeds—this being known as the "Bread Nut," also an important food of the natives in the countries where the trees are grown.

"Jack Fruit" (*Artocarpus integrifolia*, Linn.), a tree of Southern Asia, is remarkable for its large fruit developed on the trunk; used as food by the natives of India. The seeds of "Okwa" or "African Bread Fruit" (*Treculia africana*, Dec.), of West Africa are ground up into meal and used there for food. The "Bagolaro" or "Nettle Tree" (*Celtis australis*, Linn.), native of the Mediterranean region, is cultivated in Southern Italy, France, &c., as an ornamental tree and on large areas for the timber; the fruit known as "Honey Berry" is eaten in Spain and Greece (*K.B.* 1914, p. 348). The "Common Nettle" (*Urtica dioica*, Linn.), a weed in Europe, is stated to be grown for forage in Sweden, recommended in Portugal and France—the cut plants withered or dried as hay lose their stinging properties and the composition is similar to that of best meadow hay—said to be suitable for dairy cows in amounts not exceeding one-quarter of the weight of the ration, for pigs mixed with offals and potatoes and for poultry finely powdered and mixed with offals, potatoes or flour (Inter. Rev. Sci. & Pract. Agric. Rome, Jan. 1917, p. 77); used in Hungary for fodder (Nat. Food Journ, June 12th, 1918, p. 496).

JUGLANDACEAE.

Carya alba, *Nutt.*; Shell-bark Hickory.

A tree upwards of 80 ft., of North America, where the nuts are an important article of commerce, most of the Hickory nuts on the market being produced by this species (*K.B.*, 1911, p. 305).

Carya olivaeformis, *Nutt.*; Pecan Nut.

A tree upwards of 80 ft., of the Southern United States; nuts imported into the markets of this country for dessert.

Carya porcina, *Nutt.*; Pig Nut.

A tree, 80 ft., of North America; nuts edible, but not so important as other species in America on account of the thick shells and small kernels.

Carya sulcata, *Nutt.;* Big Shell-bark Hickory.

A tree 100 ft., of North America, where the nuts always find a ready market.

Carya tomentosa, *Nutt.*; Mocker Nut Hickory.

A tree 90 to 100 ft., indigenous to the middle and southern States of North America, from the coast westwards to Nebraska and Kansas. The nuts are an important article of trade and the tree is cultivated for their production as well as for timber (l.c.).

All the Hickories mentioned have been introduced into England, but are not grown on a forest scale.

1. 1911, "The Hickories," pp. 304-307.

Juglans regia, *Linn.*; Common Walnut.

A tree of the Caucasus and Armenia, extending to the Himalayas and well-known in Britain, where the nuts are dried for dessert and the fruits often pickled in a green state—this being one of the standard "pickles" commonly sold; dried ripe nuts are imported from the south of France. An oil is obtained from the kernel that may be used as salad oil.

CUPULIFERAE.

Corylus Avellana, *Linn.*; Common Hazel, Filbert, Barcelona Nut, Cob Nut.

A large bush, 10 to 15 ft., of Europe, Western Asia, &c.

Corylus Colurna, *Linn.*; Constantinople Hazel, Turkey Filbert.

A tree 60 to 80 ft., of South East Europe, Asia Minor, extending to the Himalayas.

Filberts and Cob Nuts are grown largely in Kent. Barcelona Nuts are imported from Tarragona in Catalonia, Spain, and Turkey Filberts from Smyrna, well-known as dessert nuts and used also in the preparation of nut-foods.

Corylus Jacquemontii, Dec. (*C. lacera*, Wall.), a moderate-sized tree of North West Himalaya, bears nuts smaller than those of the European Hazel, but they are "nearly as good and

are largely eaten, being exported from the various hill stations in the Himalaya" (Watt), to other parts of India.

1. 1911, "*Corylus Colurna* var. *chinensis*," pp. 327-328; 1913, "A Himalayan Tree Hazel," pp. 163-164.

The Acorns of the "Sweet Acorn Oak" (*Quercus Ilex*, Linn. var. *Ballota*), of Spain and Portugal are sold in the markets of Spain and Morocco, where they are used as food. The Acorns of "Turkey Oak" (*Q. Cerris*, Linn.), of Europe, Asia Minor, &c., and "Common Oak" (*Q. pedunculata*, Ehrh., and *sessiliflora*, Salisb.), of Europe and Asia, have been used and recommended for feeding stock, pigs especially. The fruits or "mast" of "Common Beech" (*Fagus sylvatica*, Linn.), of Europe, Asia Minor, &c., have been recommended for a similar purpose and from these also an oil is obtained in Southern Germany and France, suitable for table use.

1. 1894, "Table Oils from Beech and Linden," p. 218.

2. Sept. 1914, "The Value of Acorns, Horse Chestnuts and Beech Mast as Food for Stock," pp. 511-528; Oct., 1915, "The Feeding of Acorns to Live Stock." pp. 686-687; Oct., 1916, "Food Value of Acorns, Horse Chestnuts, and Beech Mast." p. 690; Nov., 1917, "Acorns for Pig Feeding," pp. 922-923; Aug., 1918, "Acorns as Food for Poultry." pp. 573-576.

3. No. 13, 1917, "Acorn Poisoning"; No. 291, 1917, "The Food Value of Acorns and Beech Mast."

Castanea sativa, *Mill.*; Sweet Chestnut.

A large tree of Southern Europe, North Africa, Orient, &c. The nuts are an important article of food in the Apennines (Mus. Kew), and in most countries where grown; imported into the United Kingdom from Spain and other South European countries. the largest and best nuts being obtained from cultivated trees grafted on wild stocks. Introduced to the North-West Himalaya. where the nuts are sold in the bazaars. Smoked and dried chestnuts and flour are shown in the Kew Museum, as used for food at Castagliano in the mountains of Pistoja, Italy.

1. 1890, "Chestnut Flour," pp. 173-174.

Scitamineae.

Musa sapientum, *Linn.*; Banana.

A herbaceous perennial, varying in height from about 20 to 25 ft.; cultivated in many tropical countries—Asia, Africa, America, Queensland, West Indies, &c. The principal supplies of fruit are chiefly from Costa Rica (2,614,186 bunches), Colombia (2,555,504 bunches), Canary Islands (2,138,080 bunches), and British West Indies (499,763 bunches), the remainder, 32,451 bunches, from Foreign Countries not enumerated, making a total of 7,539,984 bunches for 1913.

The banana grown in Jamaica and Costa Rica is the variety "*Gros Michael*," which grows 18 to 20 ft. high (Fawcett) with fruit larger and coarser than that of the "Canary Banana" (*Musa Cavendishii*, Lamb.), a smaller plant growing about 6 ft. high. The var. *paradisiaca* is the "Plantain," grown in the

Tropics, used as a vegetable, eaten cooked, and as an article of food it is indispensable to the natives of the countries where grown.

1. 1894, "Species and Principal Varieties of *Musa*," pp. 229-314 (reprinted as Additional Series VI. ii); 1908, "Banana Cultivation in Egypt," pp. 102-105; 1913, "Varieties of Plantains and Bananas Cultivated in the Seychelles," pp. 229-231.

Zingiber officinale, *Rosc.*; Ginger.

A perennial about 2 ft. high, cultivated in Asia, West Africa Sierra Leone, &c., in the West Indies—Jamaica especially, &c., for the rhizomes, dried for use as a spice and the green rhizome is preserved in syrup. The imports of ginger into the United Kingdom come chiefly from British India (23359), British West Indies (12311), Sierra Leone (6767), Japan (1146), other Foreign Countries (283) and other British Possessions (122), not enumerated to a total of 43,988 centals in 1913. The rhizomes of *Alpinia nutans*, Rosc., are sometimes used in India as a substitute for the true ginger.

1. 1892, "Chinese Ginger," pp. 16-20; "Fiji Ginger," pp. 77-81.

Maranta arundinacea, *Linn.*; Arrowroot.

A perennial, 2 ft. high and upwards, native of Tropical America, Brazil and West Indies. Cultivated for the starch obtained from the rhizomes, produced largely in Bermuda and St. Vincent. "Queensland Arrowroot" is the starch obtained from the tuberous roots of *Canna edulis*, Ker.

The imported Arrowroot from the British West Indies amounted in 1913 to 40,160, and from other British Possessions 615 centals.

The rhizomes of "Turmeric" (*Curcuma longa*, Linn.), cultivated in India, East Indies, Ceylon, &c., are used largely as a condiment in India and in the preparation of "Curry Powder." The tubers of "Topee Tamboo" or "Tokee Tambo" (*Calathea Allouya*, Lindl.), are used as food in Trinidad and Dominica; the plant is widely distributed in Tropical America.

1. 1892, "Allouya Tubers (*Calathea Allouya*)," pp. 244-245; 1893, "St. Vincent Arrowroot," pp. 191-204, 360-361; 1893, "Arrowroot (*Canna edulis*)," pp. 331-333; 1898, "Bermuda Arrowroot," pp. 50-51.

Ananas sativus, *Schult. f.*; Pine Apple.

An annual plant, perennial by suckering freely, commonly cultivated in the Tropics, and to a small extent in hot-houses at home. Fresh fruit is largely imported from the Azores, grown under glass, and from Teneriffe; preserved fruit from Siam, Hawaii, Florida, Straits Settlements, Australia, &c., 302,086 centals being imported in 1913.

Puya edulis, Morren, yields a starch from the leaves, reported to have saved the lives of thousands of Indians in Brazil during famine (*K.B.*, 1889, p. 20).

Taccaceae.

Tacca pinnatifida, *Forst.*; Tacca Arrowroot, Southsea Arrowroot.

A herbaceous perennial plant with globose rootstock, native of Fiji, South Sea Islands, and found in Tropical Africa.

The arrowroot or starch obtained from the root is an important food of the natives of the South Sea Islands. "Tacca Arrowroot" is preferable to any other in cases of dysentery and diarrhœa." Tubers received at Kew in 1890 from Fiji were distributed to the botanical departments of Jamaica, Trinidad, and Lagos (*K.B.*, 1892, p. 51).

Dioscoreaceae.

Dioscorea alata, *Linn.*; The Wing-stalked Yam, Barbados Yam. **D. bulbifera,** *Linn.* (*D. sativa*, Benth.); Common Yam, Otaheite Potato, of Tropical Asia, Africa, America, West Indies, &c. **D. fasciculata,** *Roxb.*; the Kidney-shaped Yam, Karem Potato, of India.

Climbing perennials, of which there are many varieties under each species cultivated in the countries named. The tuberous roots are an important food, to a large extent occupying much the same place in the Tropics as the potato in temperate countries.

The rootstocks of "Elephant's Foot" (*Testudinaria elephantipes*, Lindl.) may be mentioned as somewhat of a curiosity, called "Hottentot's Bread," the fleshy inside having been used as food by the Hottentots in times of scarcity.

Liliaceae.

Allium Cepa, *Linn.*; Onion.

A bulbous annual, cultivated in many temperate, sub-tropical and tropical countries. In addition to a large trade in home-grown produce, of which a large proportion is grown in Bedfordshire, onions are imported from Spain (5,074,087 bus.), Egypt (1,709,934 bus.), Holland (1,522,133 bus.), France (264,022 bus.), Belgium (250,774 bus.), Germany (150,334 bus.), Portugal (90,993 bus.), Malta & Gozo (31,250 bus.), &c., to the amount in 1913 of 9,105,164 bushels.

The "Leek" (*Allium Porrum*, Linn.), "Garlic" (*Allium sativum*, Linn.), "Shallot" or "Eschalot" (*Allium ascalonicum*, Linn), and "Chives" (*A. schoenoprasum*, Linn.), are well-known vegetables of the genus. "Bibrous" or "Bibraz" (*Allium triquetrum*, Linn.), is used like the Leek in Algeria, where it is very common on the littoral, especially in the neighbourhood of dwellings and in gardens, and the plants are collected in great numbers by women in the hedge-rows and fields.

1. 1913, "*Allium triquetrum* as a Vegetable," pp. 239-240.

2. June, 1897, "Effect of Wild Garlic on Milk," pp. 73-75; Dec. 1902, "The Brined Onion Industry," pp. 349-354 (see also "Report on the Dutch Brined Vegetable Industry," Cd. 1368 (1902); March, 1895, "Cultivating Onions in Egypt," pp. 333-335; Nov. 1911, "The Cultivation of Onions," pp. 638-642; March, 1918, "Is Onion Growing Worth While?" pp. 1378-1384; April, 1917, "The Cultivation of the Leek," pp. 66-68.

3. No. 264, 1912, "The Cultivation of Onions."

The flowers of *Hemerocallis graminea*, Andr. (*H. minor*, Mill.), and of *Lilium bulbiferum*, Linn., are used by the Chinese for flavouring soups and also eaten as a vegetable, and the bulbs of *Lilium cordifolium*, Thunb., are used as food in Japan and by the Ainos (*K.B.* 1889, pp. 116-118).

Asparagus officinalis, *Linn.*; Asparagus.

A perennial with creeping rootstocks, commonly cultivated in gardens for the young and tender shoots used as a vegetable. The home-grown supplies are augmented from Paris and Southern France.

2. June, 1906, "The Cultivation of Asparagus in Brunswick," pp. 154-159; Oct., 1911, "Commercial Asparagus Cultivation," pp. 551-557.

PALMEAE.

Phoenix dactylifera, *Linn.*; Date Palm.

A tree, 40 to 80 ft. high, sometimes reaching 100 ft. common in Southern Europe, North Africa, and the Orient, including many varieties; cultivated in India, Baluchistan, California, Arizona, Texas, Australia, Canary Islands, and many hot, dry countries. In desert regions like that of the Sahara in Northern Africa, the fruit is of first importance to the inhabitants. In Mesopotamia as well as being of importance to the people, dates are largely used for feeding cows.

Dried dates are imported into the United Kingdom from Turkey in Asia, France, British India, Persia, Egypt, Gibraltar, &c., the amount in 1913 being 625,866 centals.

1. 1895, "Date Cultivation in South Australia," pp. 161-162; 1896, "Date Cultivation in Antigua," pp. 26-28; 1898, "Date Production in Bussorah," pp. 46-50; 1908, "Cultivation of the Date Palm in Mesopotamia," pp. 283-286; 1914, "The Sex of Date Palm Seedlings," pp. 159-162.

Metroxylon Sagu, *Rottb.*; Spineless Sago Palm, of the East Indies, common in Sumatra and adjacent islands and in Borneo.

M. Rumphii, *Mart.*; Thorny Sago Palm, of New Guinea, Moluccas, and Amboyna, and in Borneo.

Both palms are felled to extract the starch, known as "Sago" from the trunk. The first mentioned is the principal source of the "Sago" that is imported into Europe. The cultivation of the Sago Palms appears to be limited to their native habitats.

1. 1894, "Sago Cultivation in North Borneo," pp. 414-417.

Elaeis guineensis, *Jacq.*; Oil Palm, African Oil Palm.

A tree upwards of 100 ft. high, native of West Africa; introduced to Labuan, Federated Malay States, Seychelles, Sumatra, Queensland, Jamaica, &c. Oil is obtained from the pericarp of the fruit, used for food in West Africa, "palm oil chop" being a standard dish. The kernels are shipped to Europe for crushing; they yield an oil used in much the same way as that of the "Coconut," in the manufacture of margarine, &c., and the

residual cake is an important feeding stuff for stock. The imports of palm kernels into the United Kingdom in 1913 amounted to 1,675,453 centals, coming chiefly from Nigeria (1132835), the remainder from Sierra Leone, Gold Coast, Gambia, Liberia, Cameroons, Togoland, Belgian Congo, French and Portuguese West Africa.

1. 1889, "Oil Palm in Labuan," pp. 259-267; 1891, "African Oil Palm," pp. 190-192; 1892, "Lagos Palm Oil," pp. 200-208; 1909, "The Varieties of the Oil Palm in West Africa," pp. 33-49; "The Economic Aspects of the Oil Palm," pp. 161-184; 1914, "The Varieties of Oil Palm in West Africa," pp. 285-288; 1918, "The West African Oil Palm," pp. 121-124; "The Oil Palm in the Cameroons," pp. 197-198.

2. Nov. 1914, "Palm Nut Kernel Cake," pp. 697-701; Jan. 1916, *ibid.*, pp. 998-1001; July, 1916, "The Influence of Palm Kernel Cake on the Production of Milk and Butter," pp. 305-320; "Palm Kernels and Palm Kernel Cake," pp. 363-366; Nov. 1916, "Palm Kernel Cake," pp. 734-749; Dec. 1916, "Palm Kernel Cake and Meal as Food for Pigs," pp. 850-859.

3a. No. 20, 1917, "Coconut Cake and Palm Kernel Cake."

Cocos nucifera, *Linn.*; Cocoa- or Coco-Nut.

A tree 60 to 100 ft. high, widely distributed in tropical countries near the sea.

"Cocoa-nut butter" is an edible fat prepared from the Copra or kernel of the nut and refined oil or solid fat is very largely used in the preparation of margarine and other food-stuffs. The cake ("Poonac" in Ceylon) is an important cattle food.

Copra to the amount of 691,443 centals was imported in 1913, chiefly from Australia and New Zealand (the produce of the South Sea Islands), Straits Settlements and Federated Malay States, Philippine Islands and Guam, French Possessions in the Pacific, Dutch East Indies, Mauritius, Portuguese East Africa, Fiji Islands, &c., and nearly double the above quantity of oil, refined and unrefined, came from Germany, Denmark, Ceylon, Australia, France, Belgium, Holland, United States, &c.

1. 1890, "Cocoa-nut Butter (*Cocos nucifera*)," pp. 230-238.

2. June, 1901, "Cocoa-nut Butter," pp. 101-102; Feb. 1915, "Cocoa Nut Cake and Palm Nut Kernel Cake," pp. 1025-1032; May, 1916, "Feeding Coco-nut Cake on Grass," pp. 117-123.

3a. No. 20, 1917, "Coco-nut Cake and Palm Kernel Cake."

The "Palmyra" or "Black Run Palm" (*Borassus flabellifer*, Linn.), a tall palm, native of Tropical Africa, cultivated in India, Burma and Ceylon for the extraction of "toddy," from which the spirit "arrack" is distilled; the "Nipa" (*Nipa fruticans*, Wurmb.), a low-branched palm found in the Sundribuns of India and in swampy regions of Malaya, Ceylon, Australia, &c.; is an important source of potable alcohol in the Philippines, and the "Wine Palms" (*Raphia vinifera*, Beauv. and *R. Hookeri*, Mann.), of West Africa also yield a beverage called "Palm Wine," everywhere consumed by the natives. The "Chilian" or "Coquito" Palm (*Jubaea spectabilis*, H. B. & K.), yields a honey from the sap of the trunk; the kernels are

edible and are made into confectionery (*K.B.* 1906, p. 175). The refuse of the "Vegetable Ivory Nut Palm" (*Phytelephas macrocarpa*, Ruiz. & Pav.), of Central America and New Grenada, commonly imported for making buttons, &c., has been recently recommended, ground into meal for feeding stock (Inter. Rev. Sci. & Pract. Agric., Rome, March, 1917, pp. 406-409). The kernels of the "Cohune" Palm (*Attalea Cohune*, Mart.), of Honduras, Guatemala, &c., yield an oil similar to that of the "Coco-nut," and it has been suggested for similar uses.

Aroideae.

Colocasia Antiquorum, *Schott*; Coco Yam (West Africa), Taro (Pacific Isles), Eddo, Dasheen, Tania or Tanier (West Indies), Malanga (Cuba), Yautia Malanga (Porto Rico).

A perennial, commonly grown in tropical countries for the tuberous roots; an important food—eaten like yams (*Dioscorea*) or potatoes—of the natives everywhere. As "Dasheens" the corms are cultivated in the Southern United States as a substitute for potatoes and under the name "Malanga" are brought from Cuba to Tampa, Florida, for the Latin-American people of that city. "Taros" are also shipped from China to America, where they are sold in Chinese shops as "China Potatoes" (Bull. Dept. Agric. Trinidad, Part 1, 1918, pp. 29-39).

The "Yautia" (*Xanthosoma saggittifolium*, Schott) is cultivated in Tropical America, Porto Rico, &c., for the roots for food, used like those of the foregoing.

Arum italicum, Mill., a native of Britain, is cultivated in the Channel Islands for the Arrowroot obtained from the roots, and the common "Cuckoo Pint" (*Arum maculatum*, Linn.) yields a starch from the tubers, known as "Portland Arrowroot." The tubers of *Amorphophallus campanulatus*, Blume, contain a large quantity of starch and are cultivated for food—eaten like yams—in India (Mus. Kew).

Algae.

Eucheuma papulosa, *Cotton & Yendo*; Japanese Seaweed, Tosaka Nori, Crimson Weed or Hong-tsay (China).

A seaweed found in the Red Sea, off Somaliland, Formosa, Japan, and Sandwich Islands. In Japan "the collected weed is dried in the sun and sold in the markets, where several varieties, according to the colour, substance, and shape, are distinguished by dealers; it is prepared into isinglass and is used as food."

1. 1914, "The Japanese Seaweed Tosaki Nori," pp. 219-222.

Several other species of Algae are used as food, among which may be mentioned "Jelly Weed" (*Eucheuma speciosa*, J. Ag.), a gelatinous seaweed found on the coast of Western Australia, where it is collected and used for making jelly. The "Kombu" or "Kobi" (*Laminaria longissima*, Miyab., *japonica*, Aresch., and other species) is prepared for food in Japan and "Nori" (*Porphyra vulgaris*, Ag.), common around the coasts of Japan, is collected there, and also cultivated for food "by placing

branches of trees in the mud of the sea" (Useful Pl. Japan (Agric Soc., Japan, Tokyo), 1895, p. 37); or "slender bushy twigs are planted in regular rows in shallow and brackish water, enough space being left between the rows to permit the passage of canoes" (Postelsia, Minnesota, 1901, p. 9); also common on the coasts of Britain, as "Laver" it has been sold in Swansea for making a kind of bread (Mus. Kew) and in other parts of the British Isles is commonly collected and used as a vegetable. "Ceylon Moss" (*Gracilaria lichenoides*, J. Ag.), found on rocks in the Indian and Malayan Seas, is collected and made into jelly. "Carrageen Moss" or "Irish Moss" (*Chondrus crispus*, Lyngb.), abundant on the rocky coasts of Britain, is collected in Scotland and Ireland for cattle feeding, and it has been used recently in hospitals as a substitute for Isinglass. "Tengusa" (*Gelidium* spp.) is used after special preparation for food in Japan, where it is manufactured into "Agar-agar," "Kanten," or "Japanese Isinglass."

It is convenient here to mention the *Lichens*—"Reindeer Moss" (*Cladonia rangiferina*, Hoff.), common on heaths in sub-alpine, alpine and cold regions, a winter food for reindeer in Lapland; "Iceland Moss" (*Cetraria islandica*, Ach.), of the frigid zones, used for food, and *Lecanora esculenta*, Eversm., the "Manna" of the Bible, common in Persia, deserts of the East and North Africa, often forming drifts several inches deep in valleys and collected by the inhabitants for food (Mus. Kew).

Fungi.

Agaricus campestris, *Linn.*; Common Mushroom.

Abundant in fields in Europe and cultivated in Paris and at home for market—a well-known esculent.

2. June, 1896, "The Mushroom Industry of Paris," p. 59; Jan. 1906, "Mushroom Spawn Making," pp. 592-596; Feb. to June, 1910, "Edible and Poisonous Fungi," with coloured plates (issued in pamphlet form); April, 1913, "The Cultivation of the Mushroom," pp. 30-33; July, 1917, "The Nutritive Value of Edible Fungi," pp. 416-419.

3. No. 276, 1914, "The Cultivation of the Mushroom."

Hirneola polytricha, *Mont.*; Jew's Ear Fungus.

A fungus found on wood in New Zealand, India, Java, &c. Large quantities are exported from New Zealand to China, where it is also cultivated for food.

1. 1890, "An Edible Fungus of New Zealand," pp. 217-220.

Tuber aestivum, *Vitt.*; **T. melanosporum,** *Vitt.*; Truffles.

A tuberous-like fungus included in *Ascomycetes*, found a few inches underground in Oak, Elm, and Ash forests, the first-mentioned in England—Hampshire, Kent, Sussex and Wiltshire—and the latter in the warmer parts of France and Germany. Perigord in France is the most important source of supply to the United Kingdom; the truffles are found by pigs specially trained for the purpose.

Tuber indicum, Cooke & Mass., is eaten by the Natives in the Himalayas. *Morchella esculenta*, Linn., is found amongst grass in Europe and Asia, commonly eaten and well-known in the markets as "Morel." *Cyttaria Darwinii*, Berk., a fungus parasitic on "Evergreen Beeches" (*Nothofagus betuloides*, Blume), in Tierra del Fuego, where it affords for several months the staple food of the inhabitants. *Cytarria Gunnii*, Berk., of Tasmania, and *C. Berteroi*, Berk., of Chile are also eaten in their respective countries. Darwin says (Voy. "Beagle," p. 85) of the *Cytarria* in Tierra del Fuego that "the fungus in its tough and mature state is collected in large quantities by the women and children and is eaten uncooked," and that "with the exception of a few berries, chiefly of a dwarf *Arbutus*, the natives eat no vegetable food beside this fungus." The "Fairy Ring Champignon" (*Marasmius oreades*, Fr.), so named because of its habit of growing in rings on lawns and in old pastures, is a familiar esculent.

There are many more Fungi and Algae that could be mentioned as edible, and so also many more plants among the Phanerogams above recorded, but the mere enumeration of them would extend the list out of all proportion to their value; the more important it is believed are all included, and of these there is perhaps scarcely a subject on which an extensive article, pamphlet, or even a book, might not be written. A few that are singular in Orders not prominent for their food value may be referred to as:

Rhamneae, "Indian Jujube" or "Chinese Date" (*Zizyphus Jujuba*, Lam.), fruit preserved in syrup, an important food in China and other eastern countries; fruits are also often dried, and they have occasionally come into the London market.

Caryophyllaceae.—"Spurrey" (*Spergula arvensis*, Linn.), a common weed of Europe, grown in Belgium as a forage crop for sheep (see Journ. Bd. Agric., "Spurrey as a Forage Crop on Sandy Soils," March, 1912, pp. 1020-1024, and June, 1912, pp. 214-215).

Bixineae.—"Madagascar Plum" (*Flacourtia Ramontschi*, L'Herit.), of Tropical Africa and India; fruits eaten raw or cooked, leaves used as cattle fodder in India. "Kei Apple" (*Aberia Caffra*, Harv. & Sond.), of South Africa; fruits pickled or otherwise preserved.

Portulaceae.—"Purslane" or "Pig-weed" (*Portulaca oleracea*, Linn.), a common weed in India, Africa, Australia and America; may be used as a pot-herb or vegetable, and the seeds are largely used for food by the natives of Australia (Maiden).

Proteaceae.—"Queensland Nut" (*Macadamia ternifolia*, F. Muell.), of Eastern Australia; "Wild Almond" (*Brabejum stellatum*, Thb.), of South Africa; and "Avellano" or "Guevuin" (*Gevuina Avellana*, Mol.), of Chile; all have edible seeds.

Elaeagnaceae.– "Trebizonde Date" (*Elaeagnus orientalis*, Linn.), of the Orient; fruits eaten.

Araliaceae.—"Udo" (*Aralia cordata*, Thunb.), cultivated in Japan, in gardens and fields for the root and young shoots as a vegetable.

Conifereae.—"Pignon" or "Stone Pine" (*Pinus Pinea*, Linn.); seeds sold for food in the markets of Lisbon. "Bunya-Bunya" Pine (*Araucaria Bidwilli*, Hook.), Queensland; seeds an important source of food of the aborigines of Moreton Bay.

Gingkoaceae.—"Maiden Hair Tree" (*Gingko biloba*, Linn.); kernels edible; sold in most market-towns of China ("Trees of Great Britain and Ireland," Elwes & Henry, i. p. 56).

Cyperaceae.—"Nut Grass," "Tiger Nut," "Chufa" or "Zulu Nut" (*Cyperus esculentus*, Linn.), a common weed in Southern Europe, Tropical and South Africa, in America and other warm countries; tuberous roots eaten, sometimes seen in shops of this country; bulbs roasted and eaten in Damara-land" (Fl. Trop. Afr. viii. p. 356), and other species.

Filices.—"Bracken" (*Pteris Aquilina*, Linn.), wild in many temperate countries; root-stocks and young fronds ground into meal, suggested for feeding pigs and poultry (see Journ. Bd. Agric. March, 1917, pp. 1252-1255); a farinaceous food has been obtained from the rhizomes for use as food in Britain in times of scarcity, and there is, in the Museum at Kew, a sample of meal prepared from the same, used as food in Japan, also rhizomes under the name "aruhe," stated to be formerly roasted and eaten by the natives of New Zealand. In general, as a famine food or substitute for better things, this plant would appear to be one of the commonest; Darwin observes (l.c.) that "in New Zealand, before the introduction of the potato, the roots of the fern were largely consumed."

Further particulars of these plants and others of like value, together with those of first importance, will be found in the following works, the list, it is desirable to add, not being submitted as exhaustive:—

Kew Bulletin.—"Colonial Fruit," Nov., 1887, pp. 1-20; 1888, pp. 1-23, pp. 177-252. "The Fruits of Mysore," 1889, pp. 21-28. "Cold Storage of Fruit," 1894, pp. 187-189; 1896, pp. 33-36. "Cultivation of Vegetables," 1894, pp. 219-223: 1895, pp. 307-315. "Fruit Growing at the Cape," 1897, pp. 191-199. "Famine Plants in Zululand," 1898, pp. 51-54. "Australian Pasture Herbs," 1909, pp. 12-16. "Cold Storage of Fruit and Vegetables," 1914, pp. 11-16. "Notes on Fruit Growing in the East Africa Protectorate," 1914, pp. 268-273. "The Economic Properties of some Hardy Ornamental Fruits," 1914, pp. 339-345.

"The Useful Plants of Great Britain," C. P. Johnson & J. E.

Sowerby, pp. 1-324, illustrated, col. plates (Robert Hardwicke, London).

"Food Grains of India," A. H. Church, pp. 1-180, illustrated (Chapman & Hall, Ltd., London, 1886); Suppl. pp. 1-23 (1901).

"Human Foods and Food Adjuncts" and "Forage Plants," pp. 1-144 in "Useful Native Plants of Australia," J. H. Maiden (Trübner & Co., London, and Turner & Henderson, Sydney, 1889).

"Famine Foods" in "Dict. Economic Products of India," G. Watt, vol. iii. (1890), pp. 313-320. "Food and Fodder," J. F. Duthie, *ibid.*, pp. 407-437. "Camel Fodders," *ibid.*, ii. (1889), pp. 58-63.

"The Forage Plants of Australia," F. Turner, pp. 1-94, illustrated (Govt. Printer, N.S. Wales, 1891).

"The Fruit Growers' Guide," J. Wright, vols. i.-iii; 46 col. plates (J. S. Virtue & Co., Ltd., London, 1892).

"Permanent and Temporary Pastures," M. J. Sutton, illustrated, pp. 1-204 (Simpkin, Marshall, Hamilton, Kent & Co., Ltd., London, 1895).

"Vegetables" in "Vegetables & Flowers from Seeds in Tropical, Semi-tropical, and Temperate Climates," Sutton & Sons, pp. 1-131.

"A Report upon the Forage Plants and Forage Resources of the Gulf States," S. M. Tracy, U.S. Dept. of Agric. Division of Agrostology, Bull. No. 15, 1898, pp. 1-55, illustrated.

"Fodder and Forage Plants: Exclusive of the Grasses," J. G. Smith, U.S. Dept. of Agric. Div. of Agrost. Bull. No. 2, 1900, pp. 1-86, illustrated.

"A Note on the Plants used for Food during Famine and Seasons of Scarcity in the Bombay Presidency," G. A. Gammie, Records Bot. Survey, India, Vol. ii. (Calcutta, 1902), pp. 171-196.

"Famine Foods," Noel Paton & J. C. Dunlop, including Analyses of Indian Pot-herbs of *Amarantaceae*, *Chenopodiaceae*, and *Polygonaceae*, D. Hooper, The Agricultural Ledger, No. 6, 1904, pp. 37-72.

"Food for the Tropics," T. M. Macknight, pp. 1-116 (W. Thacker & Co., London, 1904).

"Les Plantes Potagères," Vilmorin-Andrieux & Co., pp. 1-804, illustrated (Paris, 1904): English Translation, "The Vegetable Garden," W. Robinson, pp. 1-782, illustrated (John Murray, London, 1905).

"The Commercial Products of India," G. Watt, pp. 1-1189 (John Murray, London, 1908), numerous notes on food plants.

"Food Stuffs": Selected Reports from the Scientific and Technical Dept. Imp. Inst., Colonial Report, Misc. No. 71, 1910, pp. 1-267 (H.M. Stationery Office)

"Spices," H. N. Ridley, pp. 1-449 (Macmillan & Co., Ltd., London, 1912).

"Fruits des pays chauds," P. Hubert, pp. 1-728, illustrated (H. Dunod & E. Pinat, Paris, 1912).

"Fatty Foods: Their Practical Examination," E. R. Bolton

& C. Revis, pp. 1-371, illustrated (J. & A. Churchill, London, 1913).

"The Valuation of Feeding Stuffs," A. Smetham (Journ. Roy. Lancashire Agric. Soc.), reprint pp. 1-32 (J. Mawdsley & Son, Liverpool, 1914).

"Oil Seeds and Feeding Cakes" (Imp. Inst. Monograph), pp. 1-112 (John Murray, London, 1915).

"Forage Plants and Their Culture," C. V. Piper, pp. 1-618 (The Macmillan Co., New York, 1915).

"The Food Plants of the Philippines," P. J. Wester in "The Philippine Agric. Review," ix. No. 3, 1916, pp. 149-258, plates i.-xii.

"Final Report of the Departmental Committee appointed by the President of the Board of Agriculture to consider the Production of Food in England and Wales," pp. 1-11 (H.M. Stationery Office, 1915).

"The Food Supply of the United Kingdom: A Report drawn up by a Committee of the Royal Society at the request of the President of the Board of Trade," pp. 1-35 (*idem*, 1915).

"Eleven Important Wild-Duck Foods," W. L. McAtee, U.S. Dept. Agric. Bull. No. 205, 1915, pp. 1-25; Propagation of Wild Duck Foods," *idem*, Bull. No. 465, 1917, pp. 1-40.

"The National Food Supply in Peace and War," T. B. Wood, pp. 1-43 (Cambridge Univ. Press, 1917).

"Agricultural Seeds and Treatise on Permanent Pasture Grasses," pp. 1-58, James Hunter, Ltd. (Chester, 1917).

"Journal of the Board of Agriculture" (Published by The Board of Agriculture and Fisheries, Whitehall, London), numerous Papers from 1894 to 1918.

"National Food Journal," issued by The Ministry of Food, No. 1, Sept. 12th, 1917, fortnightly (H.M. Stationery Office).

"Food and How to Save it," E. I. Spriggs, including list of Food Values expressed in Calories, pp. 1-55 (H.M. Stationery Office, 1918).

II.—MISCELLANEOUS NOTES.

Sir Edward Fry.—We record with regret the death of the Rt. Hon. Sir Edward Fry, G.C.B., F.R.S., at his house Failand, near Bristol, on 18th October, 1918.

Sir Edward's interest in botany was life-long, beginning with the flowering plants of the neighbourhood of Bristol, where he was born, and ranging in later years over large areas of Cryptogamic botany and over many foreign lands. In his busy years at the Bar and on the Bench, his leisure was small, but he gratified his interest in flowers by growing orchids at Highgate. At Failand, his later home near Bristol, his garden was a source of perennial interest, and among other botanists he entertained here Dr. Asa Gray.

His interest in botany was of a philosophic rather than of a merely systematic nature, and this led him to value all variations

and exceptions; he took special interest in the Pelorias of Yellow Toadflax and Foxglove.

In middle life, finding the English flora fairly familiar to him, he turned his attention to mosses, and later to liverworts and the Mycetozoa, and with the liverworts and Mycetozoa he was materially helped by his daughter Miss Agnes Fry. In spite of somewhat awkward manipulation and eyesight that was not first-rate, he derived an immense amount of pleasure from these studies and from the thoughts they aroused in him, and he never lost sight of the broad questions of life and its nature in the study of detail. Perhaps one of the happiest moments of his botanic life was when *Buxbaumia indusiata* was brought to him in the Jura, and its interest was great for him as an early anticipation of the development of the sporophyte and almost complete suppression of the gametophyte. Another happy moment was when the long desired fructification of *Lunularia cruciata* was found on the crumbling walls of the Forum.

He sometimes complained that modern science was as hopelessly metaphysical as that of the Middle Ages, and wished at times that men of science could be induced to state and argue the debatable matters with all due forms and production of evidence as matters of fact are debated in a court of law.

We are indebted to Miss Agnes Fry for much of the information on which this brief note is based.

Hector Léveillé. — We learn that Monseigneur Hector Léveillé, Prélat de la Maison de sa Sainteté Pie X, died on November 25th, 1918. He was born at Mons on March 13th, 1863. He went to Pondicherry as Professor of Science and returned to Mons in January, 1892. He was well known as the founder and perpetual secretary of the Académie Internationale de Géographie Botanique, the official organ of which, issued at first under the title of *Le Monde des Plantes* and during recent years as the *Bulletin de Géographie Botanique*, now in its 28th volume, he edited, and to which he copiously contributed. He published numerous papers in other journals, and his studies of the family *Onagraceae* found expression in his *Monographie du Genre Oenothera*, an *Iconographie du Genre Epilobium*, and several smaller works. He was particularly interested in the flora of China, having received collections of plants from French missionaries stationed in various parts of that country, and described—often apparently hurriedly, certainly inadequately—a large number of species which he supposed to be new. He published a *Catalogue des Plantes du Yun-Nan* and issued several other compilations on the flora of China, either hectographed or in manuscript. He was an enthusiastic worker. Monseigneur Léveillé, during the last twelve years, was a frequent correspondent with Kew, and though his contributions to the Herbarium were not considerable, he was ever ready to lend specimens, and in this manner on many occasions rendered assistance to the establishment.

Claude Keith Bancroft.—With great regret we have to record the death of Mr. C. K. Bancroft, M.A., F.L.S., who recently resigned the position of Assistant-Director and Government Botanist, British Guiana, owing to ill-health. Mr. Bancroft had been unwell for some time, but had made a good recovery in Canada, where he had gone to recuperate, when he contracted influenza, followed by pneumonia, and died at Toronto on January 11th.

Mr. Bancroft received his early scientific education at Harrison College, Barbados, and in 1905 he won the Barbados Scholarship in natural science (*see* Agric. News, iv., p. 312), and was the first to win a natural science scholarship in the West Indies. Until Sir Daniel Morris was appointed Imperial Commissioner, the Barbados Scholarship was only awarded for proficiency in mathematics or classics. From Harrison College he proceeded to Trinity College, Cambridge, and in due course was elected to a major scholarship at the College, and later was awarded 1st Class Honours in the Natural Sciences Tripos in 1908. After taking the B.A. degree he devoted his attention to botany, and more particularly to mycology and plant pathology, and spent some time working at plant diseases in the Jodrell Laboratory.

In 1910 he was appointed Assistant Mycologist in the Federated Malay States (*K.B.*, 1910, p. 253), where he did much useful work, in recognition of which he was appointed, three years later, Assistant Director and Government Botanist, British Guiana (*K.B.*, 1913, p. 91). Through his untimely death agricultural science has lost a man of good promise, who can ill be spared at the present time.

Additions to Gardens.—Exchanges were difficult owing to the war, as in previous years. Consignments of plants and seeds were lost at sea or were so long on the way as to have been injured beyond recovery. Over 200 entries were made of plants, &c., received, most of these being from British sources. The most noteworthy were the following:—

Botanic Gardens and other institutions:—

Arnold Arboretum.—Seeds of trees and shrubs.

Dominica Botanic Garden.—Tubers of various species of *Dioscorea*, *Alocasia*, &c.

Jamaica Botanic Gardens.—Seeds of *Portlandia*.

Washington, U.S.A., Dept. of Agriculture.—Seeds, various trees, and shrubs.

Giza, Ministry of Agriculture.—Seeds of *Feijoa Sellowiana*.

Nairobi, Forest Dept.—Seeds of *Delphinium candidum*.

Pretoria, Dept. of Agriculture.—*Eucomis* sp., various seeds.

Khartoum, Palace Gardens.—Seeds of *Hyoscyamus muticus*.

Kirstenbosch Botanic Garden.—Seeds of Proteas, &c.

Angola Botanic Garden.—Seeds of *Raphia Sese*, native and other plants.

Uganda, Forestry Dept.—Seeds of various native trees.

Calcutta Royal Botanic Garden.—Seeds of many species of Indian plants.

Dehra Dun Research Institute.—Seeds of trees and shrubs.

Burma Forestry Dept.—Seeds of *Butea minor*.

Hong Kong Botanic Gardens.—Seeds of *Strychnos paniculata*.

Singapore Botanic Garden.—Seeds of *Canarium sp.*, *Parinarium costatum*, *Elaeocarpus Griffithii*, and *Monochoria elata*.

Sydney Botanic Gardens.—Seeds of *Telopea speciossima*.

Adelaide Botanic Garden.—Seeds of *Macrozamia Macdonnellii* and *Livistona Mariae*.

New Zealand, Government of.—Varieties of *Phormium tenax*.

Glasnevin, Royal Botanic Gardens.—20 species and vars. of *Paeonia*, *Rhododendron burmanicum*.

Edinburgh, Royal Botanic Garden.—*Castanopsis obovata*, Rhododendrons, etc.

Cambridge Botanic Gardens.—Seeds, *Columnia Banksii*, and other plants.

Greenwich Park.—*Meconopsis*, *Primula*, etc.

Receipts from other sources included the following:—

Mr. Burtt Davy, Vereeniging, S. Africa.—Seeds, *Jubaeopsis caffra*.

Mr. R. A. Dummer, Uganda.—35 packets of seeds from Mount Elgon.

Mr. A. Gosling, Paraguay.—Seeds of *Ilex paraguayensis*.

Dr. C. V. Perez, Tenerife.—Seeds of *Pinus*, *Cytisus* and *Juniperus*.

Mr. M. T. Dawe, San Lorenzo, Colombia.—Seeds of *Myristica Otoba*, *Mutisia*, etc.

Col. Longe, Norwich.—*Rhododendron carneum*.

Mr. J. C. Williams, Caerhays.—Seeds and plants of many Chinese Rhododendrons, *Picea jizoensis*.

Mr. H. St. George, Coombe House, Kingston.—Collection of Orchids.

Mr. H. J. Elwes, Colesborne.—Pleiones and other Orchids, collection of seeds from China.

Mr. E. J. Esdaile, Taunton.—Large plants of *Eucharis*, *Pancratium*, &c.

Countess Frederick Metaxa, Albany Mansions.—Orchids.

Mr. M. E. G. Young, Halsey Street, S.W.—Rhododendrons, Pines and Ferns from Simla.

Mr. W. R. Dykes, Godalming.—Irises.

Mr. Justice Rowlatt, Gloucester Square.—17 packets of seeds from India.

Mrs. Campbell, Stratford-on-Avon.—Large plants of *Trichomanes radicans*.

Sir E. G. Loder, Bart., Leonardslee.—Various trees and seeds, *Picea Breweriana*.

Mr. R. Farrer, Ingleborough, Yorks.—33 species of Chinese trees and shrubs.

Mr. H. A. Wickham.—Seeds of *Caryocar villosum*.

The Hon. Vicary Gibbs, Aldenham House.—Various trees and shrubs.

Mr. W. A. Milner, Totley Hall.—*Primula Reidii.*

Mr. H. C. Baker, Bayfordbury.—Seeds of *Fokienia Hodgkinsii.*

Mr. C. Eley, East Bergholt.—*Pterostyrax hispida* and seeds of Rhododendrons.

Mr. G. H. Johnstone, Ladock.—Various seeds from Palestine.

Lady Hanbury, La Mortola.—Seeds of *Jubaea spectabilis*, Agaves, &c.

Prof. A. Henry, Dublin.—Seeds of Macedonian Plane.

Lt.-Col. Borton, Maidstone.—Irises and various seeds from Palestine.

Mrs. Woodward, Arley Castle.—*Daphne tangutica.*

Among the purchases made were orchids for the collection and many kinds of seeds from prize ships sold by auction under Admiralty instructions.

Plants and seeds were distributed to Botanic Gardens and to regular correspondents, including collections of choice trees and shrubs to the following: Lt.-Col. F. R. S. Balfour, Dawyck; Mr. E. R. Pratt, Ryston Hall; Mr. C. Eley, East Bergholt; Mr. R. Farrer, Ingleborough; Mr. P. D. Williams, Lanarth; and Miss E. Willmott, Warley Place. Trees, shrubs, and herbaceous perennials were supplied to various military stations for the purpose of adding a cheerful note to their surroundings. A large quantity of cuttings of three Poplars, namely, *P. Eugenei*, *P. regenerata*, and *P. serotina* were supplied to H.M. Commissioner of Woods at Northampton. A large number of young trees of Canadian Maples, raised at Kew from seeds obtained from Canada, were supplied for the Canadian cemeteries in France.

The number of packets of seeds distributed was 2,200 in 88 consignments. The number of packages of plants distributed was 70.

Vegetables were again grown in most of the flower beds, including the parterre in front of the Palm House, which was planted with onions, and about 2½ acres of lawn in front of Kew Palace which was ploughed and planted with British Queen Potatoes.

Arboretum.—The labour situation has not permitted of the undertaking of any notable alterations during 1918, and the chief work during the year has been the routine work of maintaining the collections in as good a condition as possible. The most difficult problem to solve—not easy even in normal times—has been the overcrowding of trees and shrubs, owing very much to the great access of new material from China and elsewhere in the years before the war. With shrubs especially, it is rarely possible to allot sufficient space for the full development of young plants at the time they are put out.

During the last weeks of the year a considerable amount of thinning out and replanting was done in the Rhododendron Dell, and the opportunity was taken to make a wide grassy opening on the side nearest the Thames so that the visitors who find

themselves on that side of the Dell may be provided with a way into it, without having to walk to either end, or, as more frequently happened when the rhododendrons were in flower, crush their way through the bushes down the slope to the walk below.

The collection of willows has so largely increased that it has lately been quite impossible to find room for them round the margins of the lake—the original site allotted to them—without completely clothing its banks. Some years ago the collection was in consequence extended into the adjoining portion of the Queen's Cottage Grounds. This is the best position now available for them from a cultural point of view, as it is near the river and the soil is fairly good. By removing another of the plantations of nondescript trees, additional space has this winter been provided to extend the *Salix* collection there.

No storm of exceptional violence passed over Kew during the year and no loss of famous trees has to be reported. But during the summer a tree of *Hippophae salicifolia*, an ally of our native sea-buckthorn, probably the finest in the kingdom, was struck by lightning and its trunk partially stripped of bark. Judging, however, by its appearance during the autumn it seems likely to recover. In December, during a short squall, a big specimen of "crack" willow, *Salix fragilis*, at the south-east end of the lake, was blown down.

An interesting event in the grounds was the copious blossoming of many of the trees of *Davidia involucrata* in May and the subsequent development of a sufficient quantity of seeds to enable us to offer them for distribution in the annual seed list for the first time. This tree, about which so much has been written and so many expectations have centred, may now be regarded as definitely established in the British Isles. It may be worth while to mention here, in order to avoid possible disappointment and the premature throwing away of seeds that may be distributed, that they sometimes lie dormant two or even three years before germinating.

Valuable contributions of hardy trees and shrubs were made by Mr. Reginald Farrer (Chinese species), Mr. J. C. Williams (rhododendrons, &c.), The Hon. Vicary Gibbs (miscellaneous), and Mr. R. C. Notcutt (cistuses, etc).

The following new rhododendrons flowered:—*R. Houlstoni*, Hems. & Wils., *R. lucidum*, Franch., *R. neriiflorum*, Franch., *R. oleifolium*, Franch., *R. rupicolum*, W. W. Smith, *R. scintillans*, Balf. et W. W. Smith, *R. sulphureum*, Franch., and *R. trichocladum*, Franch.

Perhaps the most interesting of recent additions to the Arboretum is *Nothofagus Dombeyi*. Since the re-introduction of *N. antarctica* and *N. obliqua* by Mr. H. J. Elwes in 1902, a great interest has sprung up among tree-lovers in the 'beeches' of the southern hemisphere. So far as we know, *N. Dombeyi* has never before been introduced alive to this country. After several unsucessful attempts its introduction has been successfully accomplished through the efforts of Lieut.-Col. F. R. S. Balfour. In August, 1917, a package of several hundreds of seeds was received by him from Chile which he presented to

Kew. Most of them were dead and four seeds only germinated. but the young plants survived the winter and grew vigorously during the summer of 1918. *N. Dombeyi* is known to the Chileans as "Coigue" and is described by Mr. Elwes as a "fine beech, very abundant in the forests of the western slopes of the Andes up to about 5000-6000 ft. altitude in the neighbourhood of the Baths of Chillan." As *N. antarctica* grows in the same region at similar altitudes, one might conclude that *N. Dombeyi* ought to be as hardy as that species. It is, however, evergreen, a character which is often correlated with greater tenderness. The plants at Kew have been protected so far. but it is intended to try them in the open ground next spring. Mr. Elwes found trees below the Baths of Chillan with trunks 22 to 27 ft. in girth at 5 ft. from ground-level.

Museums.—The record for the past year is practically the same as for 1917. Additions to the collections have not been numerous and but few duplicates have been available for distribution. The staff has been fully occupied in dealing with a considerable number of varied vegetable products received from Government Departments, commercial firms, &c., for identification, and much general information bearing upon the products has been supplied.

Although details cannot be given, it should be recorded that many of the subjects dealt with have been of a confidential nature, and in this direction the museum records and collections have been fully utilised.

In several directions the permanent collections have been improved and the re-labelling in Museum No. 1 has gone on steadily. The release of two additional museum porters from the Army during the year has now made it possible for all the museums to be re-opened to the public. J. M. H.

Research in Jodrell Laboratory in 1918.—Mr. J. Bintner made some further observations on the development of callus-tissue and the formation of roots in cuttings.

Mr. L. A. Boodle continued the study of some developmental stages of the ovule of *Typhonodorum*, and carried out other anatomical investigations.

Miss M. S. G. Breeze examined the pollen of several plants in relation to the sterility of certain hybrids, &c.

Mr. W. C. Worsdell completed his anatomical study of the *Compositae*, and continued that of some other families.

Pathological Laboratory.—On account of the decision to separate the Board's administrative and advisory work from research, there was a tendency in 1918 for workers to confine themselves to one or other aspect of the work, though at the same time the advantages to be gained from the blending of the research and applied aspects of pathology prevented this from being exclusively the case.

With regard to the administrative side a special attempt was made to develop the Intelligence Service inaugurated last year and to obtain an idea of the plant disease situation in the country as a whole. On the research side work on problems of general importance was continued, and investigation carried out on the biology of several important parasitic fungi. As in previous years the routine duties of the laboratory interfered with experiments and research, but on the whole the various branches of pathological work were carried out successfully.

This report deals exclusively with the mycological side of the work carried out in the Laboratory. The Board's entomological staff have also worked in the same building and throughout the year the closest co-operation has been maintained between the workers in these two branches of plant-pathology.

Staff.—In connection with the approaching changes, several alterations took place with regard to the staff. Mr. W. B. Brierley commenced work at the Phytopathological Institute at Rothamsted on November 18th, and on the same day Mr. A. D. Cotton and Mrs. N. L. Alcock were transferred to the staff of the Board of Agriculture. Miss M. N. Owen also left the laboratory in October to take up work in the Department of Technical and Industrial Research, and Mr. R. Beer was appointed temporary technical assistant.

Intelligence Service.—The Plant Disease Survey (including both animal and fungus pests) was instituted last year by the Plant Disease Sub-Committee of the Food Production Department. By means of a system of monthly reports prepared by specially qualified honorary correspondents in all parts of the country, a very large amount of information was gathered. Further data were acquired by means of visits, circular letters, and special enquiries. In this way it has been possible to obtain a more accurate and detailed idea than has ever been obtained before of the incidence of disease in the country. The work of collating reports and of preparing summaries of the fungus diseases has been largely entrusted to Miss M. G. Aikman, and the report for the season will shortly be published.

Diseases.—With regard to noteworthy fungus diseases in the year 1918, the following may be mentioned. Amongst cereals a rather bad attack of Yellow Rust of Wheat (*Puccinia glumarum*) occurred throughout a very large part of the country during the early part of the season. This was in striking contrast to the previous year, when Yellow Rust was practically absent. In the eastern counties especially the attack was severe, and even resistant varieties such as "Little Joss" suffered to some extent. Much of the wheat, however, outgrew the disease as the season advanced, but in many cases the plants suffered considerably. An attempt was made to determine the susceptibility of the different varieties in different localities. Wheat Mildew was also prevalent in certain districts in July and August, especially where nitrogenous manures, such as sulphate of ammonia, had been applied freely.

Fruit suffered perhaps less from fungus diseases than usual. The distribution of American Gooseberry Mildew, which in 1917 was extremely limited, increased materially, and, as was to be expected, radiated out from the centres where it had occurred that year.

Another contrast was found in the case of Black Currant Rust (*Cronartium ribicola*), the general occurrence and abundance of which, in 1917, was phenomenal. In 1918 the rust, except when in immediate proximity to diseased Weymouth pine (its alternate host), was absent. In autumn the disease spread somewhat in a few localities, but probably in all cases starting from the infected pine centres.

With regard to vegetables, during spring damping-off of seedling tomatoes through a species of *Phytophthora* caused still further damage. Sterilisation of soil and the use of non-contaminated water have proved successful as control-measures. A leaf-blotch in cucumber, due to *Colletotrichum oligochaetum*, was estimated to cause a loss of several thousand pounds in Hertfordshire, in which county also Sleeping Disease of tomatoes is still very prevalent, destroying many thousands of plants.

Onion Diseases.—Onions received special attention. The Sclerotium disease, which has been under research for more than a year, proved very destructive last season and was discovered to exist in practically all parts of England. It was observed at Kew to attack shallots which hitherto were regarded as being immune (see under "Research," p. 96). Another serious and new disease, viz., Onion Smut (*Urocystis Cepulae*), occurred in two districts (Northamptonshire and Northumberland). This fungus is the cause of much damage in the United States; it occurs also on the continent of Europe. Although no published record of the presence of Onion Smut in Britain exists it was ascertained that the disease appeared near Edinburgh seven years ago but has been stamped out. The fungus has again established itself in Britain (probably being re-introduced with the seed), and every effort is being made to exterminate it.

Advisory Work.

Advisory work covered a large range of diseases and was particularly heavy in late spring and early summer. Owing to all questions relating to potato diseases being dealt with by the Food Production Department, the laboratory was relieved of at least 500 enquiries with regard to this crop. The number of enquiries dealt with was 730. Although most of these were answered by means of correspondence, in several cases visits were paid with profitable results. Some fifty visits to all parts of the country were paid during the course of the season. Some of the more important cases were Yellow Rust in Wheat, Failure of Oats, Barley Stripe, Wart Disease of Potato, Potato Blackleg, Apple Mildew, Apple Canker, Weymouth Pine Blister Rust, Sclerotium Disease of Onion, and the newly-introduced Onion Smut.

Special visits were paid to a large number of orchards in the

West of England in connection with the extensive damage caused by Silver Leaf. The method of infection, effect of soil-conditions, and especially the question of stocks, were studied in the field. All the most recent researches, both in the orchard and in the laboratory, tend to confirm the view that the disease in the vast majority of cases is caused by *Stereum purpureum*, which gains entrance to the tree through wounds. A lecture was given at Worcester and also demonstrations showing method of infection and destruction of the trees by the attacking fungus.

Technical advice has also been supplied to the Horticultural, Technical, and Supplies Divisions of the Food Production Department, and also to the Seed Testing Station of the Board of Agriculture and Fisheries with regard to various fungi affecting particularly seed wheat. Some sixty samples of the latter have been received for investigation. Amongst the fungi found is an interesting Pyrenomycete, the development of which is being investigated by Mrs. Alcock.

II. Research.

Botrytis.—The investigation of *Botrytis cinerea* by Mr. W. B. Brierley was continued. The work developed along two main lines. In the first of these, a study of the behaviour of the fungus in the tissues of various hosts, it was ascertained that under certain conditions the hyphae may absorb their cell-walls and exist in a free plasmodial state, the fungus passing thus from cell to cell through the pits in the walls.

The second line of work has been the investigation of the variability and specific constancy of the morphological and physiological characters of the fungus when growing under exactly controlled environmental conditions. A very great amount of data has been obtained, but the investigation is still far from complete. It is clear, however, that *B. cinerea*, is not a single species, but an aggregation of numerous elementary species; the morphological characters of any particular culture or growth of this fungus being a direct resultant of two factors, viz., the elementary species and the host or culture medium. Within certain limits, therefore, the morphological characters of specific value of the fungus are under the control of the investigator, and may be changed at will.

Rose Blotch Fungus.—The life-history of the Rose Blotch fungus was investigated by Mrs. Alcock and a new method of hibernation similar to that which occurs in Apple and Pear Scab was discovered. The results were published in the *Bulletin* (1918, p. 193).

Onion Disease.—In conjunction with Miss Owen, research on the biology of the onion Sclerotium disease was continued. The name *Sclerotinia bulborum*, under which the disease has recently passed, was found to be incorrect, the fungus in reality being *Sclerotium cepivorum*, Berkeley. The parasite was shown to attack the plant by means of the roots and to spread upwards to the base of the bulb. It forms both spores and sclerotia on the

bulbs in the soil, and although it has been grown for fifteen months in pure culture, no signs of an ascigerous stage (the spores of which would, under natural conditions, presumably be air-borne) has developed. Garden sanitation, rotation of crops, and the use of soil fungicides, are therefore required for its control. It is hoped to publish results in the spring.

Potato Disease.—Miss Owen continued her investigation on Skin Spot of the potato. The fungus was isolated and shown to be quite distinct from *Spicaria*, where it had been previously placed. From reports received through the Plant Disease Survey the disease was found to develop very widely during the winter of 1917-18 on many varieties, and is apparently increasing in abundance. The fungus, however, does not succeed in reaching the inner part of the tuber, being kept to the surface layers by the repeated formation of layers of wound-cork by the potato plant. A paper on the subject will be published shortly.

The Experimental Ground.

A further portion of the ground was laid out in 1918 and replanted with young fruit trees. A large part was again kept under potatoes, and a variety of vegetables was grown for experimental purposes. A 10-rod "allotment plot" was marked out and planted in order to obtain exact figures of the yield, in connection with statistics for the allotment movement.

In addition to the work on fungus diseases, a portion of the ground was used by the Entomologist of the Board of Agriculture for Frit Fly experiments, and for the testing of insecticides on various fruit trees.

Of the fungus diseases, mention may be made of the following:—

Black Currant Rust.—With a view to testing the theory of hibernating mycelium, 200 young bushes of black currant, very badly affected with *Cronartium ribicola*, were purchased in the autumn of 1917. No support for the theory was obtained. The growth made by these bushes in the spring was clean and showed no signs of any rust pustules, and microscopic examination of the buds and twigs, carried out in the laboratory in winter, failed to reveal any trace of mycelium.

Plans had also been made to test the value of spraying mixtures for controlling black currant rust. Spraying experiments were therefore arranged to be carried out on plots in a plantation near Norwich, which was very badly attacked last summer, as well as at Kew. By arrangement with other workers, 1 per cent. Burgundy mixture was selected as a fungicide, Bordeaux mixture and lime sulphur being tested elsewhere. The first spraying was given on the Norwich plots on June 13th, a week or so previous to the time at which an outbreak might be expected. The results of the experiments were, however, negative, since, as mentioned above, there was practically no outbreak of *Cronartium* last season and all the plots remained clean. It was, however, ascertained that 1 per cent. Burgundy mixture caused no leaf injury.

Potatoes.—Several plots were used for experimental work on the research carried out on Skin Spot. Trials also of seed-tubers affected with Sprain and *Verticillium* were also conducted. The spontaneous outbreak of a considerable quantity of the last-named disease in various parts of the ground provided copious material for the commencement of research.

Onions.—Extensive preparations were made for work on onion diseases, especially *Sclerotium cepivorum*, but no general and uniform infection could be brought about. Observations were therefore made in a neighbouring market-garden, where the disease was abundant.

Wheat.—A spontaneous outbreak of yellow rust (*Puccinia glumarum*) on wheat sown for Frit Fly experiments is worthy of record.

The following papers were published during the year:—

Diseases of Parsnips (A. D. Cotton), *Kew Bull.*, 1918, p. 8.

The Microconidia of *Botrytis cinerea* (W. B. Brierley), *Kew Bull.*, 1918, p. 129.

Notes on Regeneration in *Botrytis cinerea* (W. B. Brierley), Annals of Botany, Oct., 1918.

On the Life History of the Rose Blotch Fungus (N. L. Alcock), *Kew Bull.*, 1918, p. 193, and some ten Board of Agriculture leaflets were rewritten wholly or in part by Mr. A. D. Cotton.

Presentations to the Library during 1918.—War conditions are no doubt the cause of a marked decrease in the number of additions made to the library during the year, whether by purchase or presentation. Many of those received were published some years ago. Several of the periodical or serial publications presented by the Bentham Trustees, altogether about thirty, are or were published in Germany, Austria-Hungary, Russia, and Belgium. Since 1914 none originating in the countries named has reached Kew. The collection of drawings of orchids by Lady Barkly, and of drawings of South African plants by Miss E. B. Barkly, presented by the Bentham Trustees, has been noticed in the *Kew Bulletin*, 1918, p. 342.

Sir William T. Thiselton-Dyer has made several contributions to the library. These include a copy of Collett's *Flora Simlensis*, in which is inserted an original letter to Sir William from the late Lord Roberts, giving some details of Sir Henry Collett's military career; an interleaved copy of Sach's *Text Book of Botany*, translated and annotated by A. W. Bennett and Sir William, containing MS. additions and various original letters and published notes, and bound in four volumes with a copy of the third German edition; an interleaved copy of Pritzel's *Thesaurus Literaturae Botanicae*; *Whitaker's Almanack* from 1870-1917, 48 volumes, a complete set except for the absence of the first issue; and several pamphlets, including the third part of his work *On some Ancient Plant-names*, which appeared in the *Journal of Philology*, vol. xxxiv.

The Director of the Royal Botanic Gardens, Kew, has presented a number of publications including:—*Endemismi ed esodemismi nella Flora Italiana*, by L. Buscalioni & G. Muscatello; *Le Comte Oswald de Kerchove de Denterghem (Notes biographiques)*, by A. Ceuterick; *Bemerkungen über Hasselquist's Herbarium*, by H. O. Juel; and *The Flora of the District of the Thames Valley Drift between Maidenhead and London*, by H. W. Monckton. A copy of a *Flora of Epsom and its neighbourhood*, by T. N. H. Smith-Pearse, has been presented by the Assistant Director.

From Prof. C. S. Sargent has been received a copy of the second volume of the *Catalogue of the Library of the Arnold Arboretum of Harvard University*. This volume contains the subject catalogue, and being compiled from a rich collection of botanical literature it forms a very valuable addition to this particular group of bibliographies and will prove of great usefulness to botanists everywhere.

Dr. N. L. Britton has sent to Kew a copy of his *Flora of Bermuda*, a descriptive and illustrated work (see *Kew Bull.*, 1918, p. 247), and of his *Flora of the American Virgin Islands*, an enumeration of the plants, with localities; he has also presented a further part (vol. xxi. pt. 3, Allioniaceae) of the *North American Flora*.

The series of valuable pomological works issued by the New York Agricultural Experiment Station has been supplemented by a volume on *The Peaches of New York*, by Prof. Hedrick and others, a copy of which has been received from the Director of the Station. A short review of this work appeared in *Kew Bull.*, 1918, p. 160.

Mr. J. H. Maiden is making good progress with his elaborate *Critical Revision of the Genus Eucalyptus*, five parts having reached the library from him during the year. He has also presented a copy of part 2 of the Forestry Handbook of New South Wales, giving his account of some of the principal commercial trees of the State, and a copy of *The Flora of the Northern Territory* [of Australia], by A. J. Ewart and O. B. Davies, to which Mr. Maiden contributed appendices on the genera *Eucalyptus* and *Acacia*. Copies of this work have also been received from Prof. Ewart and the Agent-General for Victoria.

Mr. R. N. Bland has presented several works on the botany of India and the Malayan Peninsula which, though duplicating sets already in the library, will prove of much usefulness, as they are mostly books in constant demand. Amongst them are 4 volumes of Hooker's *Flora of British India*, 20 numbers, partly bound, of King & Gamble's *Materials for a Flora of the Malayan Peninsula*, with th 3 parts on the Monocotyledons by H. N. Ridley, and 4 volumes of the *Agricultural Bulletin of the Straits and Federated Malay States*.

From the Agricultural Adviser to the Government of India a copy of E. J. Butler's *Fungi and Disease in Plants* has been received (see review in *Kew Bull.*, 1918, p. 246); also *Report of the Proceedings of the Second Entomological Meeting held at*

Pusa, . . . edited by T. Bainbrigge Fletcher, and several Bulletins of the Agricultural Research Institute, Pusa.

A brochure entitled *Homenagem ao Prof. Doutor Julio Augusto Henriques*, originally published in *O Instituto*, vol. lxv., and issued in commemoration of this well-known Portuguese botanist's eightieth birthday, has been received from the Faculty of Sciences in Coimbra. On p. 25 there is a description of a new lichen, *Psorotichia Henriquesi*, Sampaio, discovered on Santa Clara Mountains, near Coimbra, where Prof. Henriques, as Professor of Botany in the University and Director of the Botanic Garden, has passed the last fifty years of his life.

In 1917 a collection of 45 letters, written by Dr. F. Welwitsch to the late Prof. Daniel Oliver, was received from Prof. F. W. Oliver (*Kew Bull.*, 1918, p. 45). Last year 25 other letters from the same source were received from him, and also 10 from Allan A. Black to Prof. D. Oliver, written after he left Kew for Bangalore in 1863. Lady Blake has presented the MS. of a *Provisional List of the Flowering Plants of the Bahamas*, by L. J. K. Brace & J. Gardiner, published in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1889. She has also presented a copy of the published list, and a copy of Ahern's *Notes on Philippine Woods*.

A *Panoramic Profile of the Hill Ranges of Sikkim*, by H. J. Harman, has been presented by Mr. J. S. Gamble, and a map of Vodena, Macedonia, and of Salonika, by Mr. W. B. Turrill.

The following have been presented by their respective authors or editors:—Phamphlets on the botany of Paraguay, by M. S. Bertoni; *The Marine Algae of the Danish West Indies*, by F. Börgesen, vol. ii., pp. 241-304, and a paper on the mosses and lichens of those islands, by F. Börgesen and C. Raunkiaer; *Relacion de un viaje por el Rio Magdalena*, &c., and the English translation, by M. T. Dawe; *The Flora of the Presidency of Madras*, by J. S. Gamble, part 2, 2 copies, from the author and the Secretary of State for India (see *Kew Bull.*, 1918, pp. 222-228); a set of the numerous leaflets on medicinal and commercial plants, compiled by Mrs. Grieve; *Plantae Thunbergianae*, by H. O. Juel (see *Kew Bull.*, 1918, p. 190); several publications on Italian botany, by C. Massalongo; *Species Blancoanae*, by E. D. Merrill (see *Kew Bull.*, 1918, p. 351); *The Horticultural Note-Book*, ed. 3, by J. C. Newsham; several *Contributions from the Botanical Department of Iowa State College*, by L. H. Pammel and others, from Prof. Pammel; *The Botany of Iceland*, edited by L. Kolderup Rosenvinge and Eug. Warming, part 2; and a number of pamphlets on Queensland botany, by C. T. White.

The more important of the other presentations are:—*Étude de la luminescence du Pseudomonas luminescens*, by A. de Coulson, from Prof. R. Chodat, who has also presented fascicles 1 and 2 of his work *La Végétation du Paraguay*, and several publications of the Botanical Institute of the University of Geneva; *Catalogue des produits de l'Indochine*, tome 1, by Ch. Crevost & Ch. Lemarié, from the Gouvernement Général de Indochine; *Planten-Atlas . . . . van Indische Planten, Vruchten*, &c., by Mrs. J. Kloppenburg-Versteegh, from

Mr. H. N. Ridley; pamphlets on plant pathology from the Department of Plant Pathology of the Cornell University Agricultural Experiment Station; six papers on fungi by J. C. Arthur, from the Purdue University; *Transactions of the Third International Congress of Tropical Agriculture*, vol. ii., from the Organising Secretaries; *Sketch of the Natural History of Yarmouth*, by C. J. & James Paget, with a few MS. additions, from Prof. C. S. Sherrington; *A Monograph of the British Lichens*, part 1, second edition, by A. Lorrain Smith, from the Trustees of the British Museum; Bulletins and Circulars of the Agricultural Experiment Station, Cuba, from the Director; *Mededeelingen van het Algemeen Proefstation der Avros*, Medan, Sumatra, from the Director of the Station; *Icones Plantarum Formosanarum*, by B. Hayata, vol. vii., from the Bureau of Productive Industries, Government of Formosa; *Journal of the Botanical Society of South Africa*, parts 1-4, from the Honorary Secretary; *Physiological Abstracts*, vols. i & ii., from the publishers, Messrs. H. K. Lewis & Co.; *Mededeellingen van de Landbouwhoogeschool*, Wageningen, from Prof. J. Ritzema Bos; a large number of the numerous useful publications of the United States Department of Agriculture, from the Secretary of the Department; and a copy of the curious little work by A. Winkler, published under the pseudonym of A. Carex, entitled *Illustrationen zur deutschen Flora in Feder-Zeichnungen*, with *Rand-Glossen*, from Dr. W. Botting Hemsley, who has also contributed, amongst other publications, portions of illustrated works with which to supplement the collection of drawings.

Additions to the Herbarium during 1918.—During the year about 5600 specimens were received as donations or exchanges, 518 were purchased, and 954 were received on loan. The principal collections are enumerated below:—

Europe.—*Presented*: Britain (John Divers), by Mr. Jos. J. Divers; Mr. C. E. Salmon. Greek Macedonia, by Capt. G. W. Harris, Sergt. J. M. Russell, and Lce.-Cpl. W. B. Turrill.

India.—*Presented*: Western Himalaya, by Shiv Ram Kashyap. Chitral, Gilgit, and Burma, bequeathed by Major S. M. Toppin. Madras, by the Madras Government Herbarium, through Mr. J. S. Gamble. Andamans, by Mr. C. E. Parkinson, through Mr. R. S. Hole.

Malaya.—*Presented*: Philippines (C. B. Robinson and others), by Mr. E. D. Merrill. Dutch New Guinea, by Miss L. S. Gibbs.

Australia.—*Presented*: Tasmania, by Miss L. S. Gibbs.

New Zealand.—*Presented*: By Mr. T. F. Cheeseman.

Polynesia.—*Presented*: Fiji, by Mr. W. Greenwood.

Tropical Africa.—*Presented*: Sierra Leone, by Mr. K. G. Burbridge and Major Guy Aylmer. Lagos, by Dr. J. M. Dalziel. Belgian Congo (R. Père Hyac. Vanderyst) by the

Minister of the Belgian Colonies. Uganda and British East Africa, by Mr. J. D. Snowden. Rhodesia, by Mr. F. Eyles. *Purchased*: R. A. Dummer, Uganda.

South Africa.—*Presented*: Transvaal, &c., by Mr. I. B. Pole-Evans.

North America.—*Presented*: British Columbia, by Miss E. M. Warren. Washington State, by Mr. J. M. Grant.

West Indies.—*Presented*: Dominica, &c., by Mr. W. Fishlock.

South America.—*Presented*: Colombia and Venezuela (Arnold and G. Schmidtchen), by Messrs. Sander & Sons.

A detailed list of the specimens collected during the military operations in Macedonia has been published in the *Kew Bulletin*, 1918, pp. 249-341. Plants from the Madras Government Herbarium have been received through Mr. J. S. Gamble, who is working out the *Flora of the Presidency of Madras*. Shiv Ram Kashyap has presented some of the new species of Hepaticae, which he has described in vols. xiii and xiv of the *New Phytologist*. Rawalpindi plants have been collected by Driver T. A. Sprague, a member of the Herbarium Staff, but now on active service. Miss L. S. Gibbs has presented specimens of her Dutch New Guinea collections, which are enumerated in her *Contribution to the Phytogeography and Flora of the Arfak Mountains*, also some of her Tasmanian plants.

Cryptogams from the Philippine Islands have been contributed by Mr. E. D. Merrill. Specimens of new species of New Zealand plants described by Mr. T. F. Cheeseman have been presented by the author. Amongst the collectors in Tropical Africa, who have continued to send specimens, are Mr. J. D. Snowden, of Uganda, Dr. J. M. Dalziel, of Lagos, and Mr. F. Eyles, of Rhodesia. The Minister of the Belgian Colonies have presented the grasses collected in the Belgian Congo region by R. Père Hyac. Vanderyst, and so enabled their determinations to be included in the volume of the *Flora of Tropical Africa*, now in the press. The Uganda specimens purchased from Mr. R. A. Dummer were those collected during the Dummer-Maclennan Expedition to Mount Elgon. Miss E. M. Warren's more recent collections from British Columbia have been made in the neighbourhood of Vernon.

Yews for the State of Georgia.—The Colony of Georgia, now one of the United States of North America, was founded by General James Edward Oglethorpe in 1732. He belonged to an ancient family long settled at Oglethorpe in West Yorkshire, and was an ardent philanthropist and colonizer. He lived for some years in Georgia, nursing the infant colony, returning in 1743 to marry the heiress of Sir Nathan Wright, who brought him a fortune, including Cranham Hall in Essex. Here he lived until his death in 1785. The Hall, now reduced to a farmhouse, is situated on a gentle eminence less than a mile outside

the village of Upminster. Very little of the building of Oglethorpe's time remains, but there are still in existence the old garden walls, with their ancient, wrought-iron entrance gates. There are also a few fine trees of considerable age, especially a specimen of *Fraxinus angustifolia* and one of *F. excelsior heterophylla*. The most conspicuous features of the garden, however, are some very old yew hedges, very bulky and shapeless, but still healthy and regularly clipped. They are thought to be between three hundred and four hundred years old; certainly they were there in Oglethorpe's time.

From its associations with the founder of their State, Cranham Hall is naturally a place of great interest to the people of Georgia, and it is visited every year by a number of pilgrims. In 1916 a request was conveyed to Kew through Mr. H. A. Alexander, from the members of a patriotic and historical society in Atlanta, the capital of Georgia, that cuttings from the old yew hedges should be taken with the view of their being ultimately transplanted to some appropriate place in that city. Kew was very willing to assist in gratifying so pleasing a sentiment, and an officer was sent to Cranham Hall to obtain the cuttings. They were successfully rooted and, after considerable delay owing to circumstances arising from the war, 500 healthy young plants were despatched to Atlanta on February 25th. W. J. B.

Echium Decaisnei and E. giganteum.—Dr. G. V. Perez, Santa Ursula, Tenerife, sends us the following notes on these two species:—"I have in my garden a solitary plant of *Echium Decaisnei* from Grand Canary, which is remarkable for its resistance to drought and the very long time it remains in flower. At a distance it is not at all unlike *Echium giganteum*, a native of Tenerife, but its leaves are much more prickly, and its flowers of course are quite different and tinged with a pretty blue.

"The curious thing about this plant is that I have not as yet succeeded in reproducing it true from seed; so far as I know, all the seed I have sown and the numerous seedlings I have collected at its base have turned out to be hybrids. In this respect this solitary *Echium* reminds me forcibly of my experience with single plants of our various species of *Statice*, which practically never come true, but always as hybrids. I have just now three young plants raised from *Echium Decaisnei*, and extremely like it, but on close inspection I have little doubt that they are hybrids of this species and *E. giganteum*. These hybrids show the great similarity there is between these two species, and they might well be taken on superficial examination for either of them. As both of them flower immediately after the first rains, they and their hybrids would be very suitable for certain parts of India, Egypt, Syria, etc. Many of our species of *Echium* are late flowerers, but these are usually out at Christmas. Another very early and pretty flowered *Echium* is *E. nervosum*, from Madeira; it is very beautiful just now (January 21st), and ought to be hybridised with the former two."

From what Dr. Perez says above it is apparent that these particular *Echiums* are not capable of self-fertilisation when grown as single isolated plants. *E. giganteum* occurs wild in a small tract of country around Dr. Perez's home (Santa Ursula) near the coast on the N.W. of Tenerife (*see Kew Bull.* 1914, pp. 118), whilst *E. Decaisnei* is confined to the island of Grand Canary. Dr. Perez speaks of the superficial resemblance of the two species; they are easily distinguished botanically, *E. giganteum* with fairly broad leaves with minute soft appressed indumentum, sometimes with a few short and slender bristles only on the margin (*see Kew Bull.* l.c. fig. 1 d), and *E. Decaisnei* with narrower leaves, fairly densely sprinkled with broad-based prickles without the appressed indumentum. A short account of the grouping of Canary Island and Madeira species of *Echium* appeared in the *Kew Bull.* 1914, pp. 265-7.

The Botanic Garden, Havana.—A Botanic Garden was founded at Havana on May 30th, 1817, under the auspices of the "Sociedad Patriótica de Amigos del Pais," and an interesting account of the present garden, which is now attached to the Institute of Secondary Education, has recently been published by Dr. Felipe Garcia Cañizares.* The volume is well illustrated with views and plans of the garden, and contains numerous plates and figures of the more interesting plants that are in cultivation. A general catalogue of the indigenous and exotic plants grown forms a valuable portion of the work as the native names of the plants are given with their scientific names, and the whole catalogue is arranged under the natural families. A special account, with figures, is given of the Ocuje (*Calophyllum Calaba*, Jacquin) and there is a complete alphabetical index.

From the historical account of the garden, which occupies the opening pages, we learn that the suggestion of establishing a Botanic Garden at Havana was first made in 1793 by Nicólas Calvo and Mariano Espinosa, but despite the efforts of these originators of the scheme, and the interest displayed by Martin Sesé, the project was not fulfilled until the year 1817, when the garden was commenced on land granted by Sr. Alejandro Ramirez.

The first Director of the Garden was Sr. José Antonio de la Ossa, the author of the "Flora havanensis."

In the year 1824 the Chair of Botany was established, and Sr. Ramón de la Sagra was appointed the first Professor, and in 1827 became exclusive Director of the Garden. He enlarged the garden considerably and also did much for the encouragement of Cuban agriculture.

The garden at a later date was united with the Institución Agrónoma in the Escuela Botánica Agricola, and was finally placed under the Real Hacienda as a State Institute.

The third Director was Dr. Pedro Alejandro Auber, the distinguished naturalist. From 1864-1897, the second epoch

* El Jardin Botánico del Instituto de Segunda Enseñanza de la Habana, por Felipe Garcia Cañizares, 1918.

in the history of the garden, there is little to record, as its scientific and administrative work was sadly neglected, except that in the year 1866 the garden became a dependency of the University. In 1897 the Director of the Institute of Secondary Education obtained a portion of the garden for his School, and it is with this part of the original garden that the present account is concerned. The garden has been restored to its proper functions under the direction of Dr. Fernando Reynoso, and to his enthusiasm and energy the present prosperous condition of the Havana Garden of the Institute of Secondary Education appears largely to be due.

British Guiana Plants.—Mr. L. S. Hohenherk, Forestry Officer of British Guiana, has published a paper under the title of "Botanical Identifications of British Guiana Trees and Plants,"* which should be useful for the reason that in numerous instances the vernacular as well as the botanical names are given. Specimens of the plants, mostly arborescent, which are enumerated in the list, were brought to Kew by Mr. C. Wilgress Anderson, I.S.O., the late Forestry Officer, and as far as possible they were identified in the Herbarium. The list is arranged in five columns in which are given numbers, vernacular names, localities, descriptive remarks and botanical names. Unfortunately many errors have crept into it, especially in the spelling of the botanical names, and some confusion must have occurred with regard to *Sagittaria lancifolia*, which, we are informed, is a nameless shrub, that it was collected on a sand beach, and that it has latex. S. A. S.

Forestry in the Uganda Protectorate.—Before the year 1917-18 the interests of Forestry, Botany, and other scientific subjects in the Uganda Protectorate were included in one department, but at the beginning of that financial year a separate Forestry Department was created, with Mr. R. Fyffe as Chief Forest Officer, who now issues the first annual report (Annual Report on the Forestry Department for the Year ended 31st March, 1918). The work of the year has been largely of a preparatory nature, including surveys, the construction of roads, the erection of houses, sheds, and a saw mill, and other work necessary to facilitate future operations. Time was, however, found to clear 170 acres of ground in the Busoga Railway Fuel Reserve, and to plant it with 820,000 young trees; to start an arboretum and nursery; to collect and distribute 697 lbs. of tree seeds; to advance work connected with a forest herbarium and museum and to collect 500 lbs. of rubber, valued at £66 13s. 4d., in the Budongo Forest. The rubber resources of this forest are to be developed, but much of the work during the past year had of necessity to take the form of road construction and housing accommodation

* Journal of the Board of Agriculture of British Guiana, vol. xi, pp. 98–106, 178–185 (1918).

for the forest official and collectors, with sheds and other offices for the reception of the latex and the preparation of the dried rubber. It was also necessary to clear 10 acres of ground for the production of food stuffs for the workers. *Markhamia* (*Dolichandrone*) *platycalyx*, is one of the best timbers of the region, and 810,000 trees of that species were planted in the Busoga Forest Fuel Reserve to 10,000 specimens of other species. Other important trees are: *Balsamocitrus Dawei*, *Cynometra Alexandri*, *Entandrophragma angolense*, *E. utile*, *Khaya anthotheca*, *Lovoa budongensis*, *Podocarpus gracilior*, *P. milanjianus* var. *arborescens*. Of introduced trees, Teak (*Tectona grandis*) appears to be growing freely, and in some places *Eucalyptus* spp. are making rapid growth. W. D.

Coprosma.—The genus *Coprosma*, first instituted by Forster in 1776; hitherto regarded as of little or no economic importance, has recently been found to possess some interest for the production of dyes from the bark. Out of about 60 species which the genus comprises, approximately half indigenous to New Zealand, the following six have been specially tested by the Department of Agriculture, New Zealand, for their dyeing capacity.—*C. grandifolia*, Hook. f., *C. lucida*, Forst., *C. Baueri*, Endl., *C. robusta*, Raoul, *C. areolata*, Cheesem., and *C. foetidissima*, Forst. These were selected because of their abundance; other species expected to be of interest were not desirable because of their rarity or small size. The first two species mentioned are stated to "fall into a class apart in giving purplish or maroon fast dyes on chrome mordants with wool and orange-scarlet (tangerine) to dark-red shades with stannous mordants and tartar in the single bath method." Of the remainder it is said: "Two very common species in Wellington, *C. Baueri* (the taupata) and *C. robusta*, have given quite negative results in dyeing tests. *Coprosma lucida*, which also has bark and wood of a yellow colour, gives good reddish-brown colours, which are fast to light and soap, to chrome and alumina mordants. *Coprosma foetidissima* (the hupiro of the Maori and the "stinkwood" of the settler), which has a light green bark, has proved a disappointment, for although giving excellent brown and yellow colours to chrome and stannous mordants respectively and fast to soap, they are not fast to light. This is more to be regretted as the plant has strong tinctorial properties and is very abundant in some districts."

For fuller information on the experiments, reference should be made to the paper from which these notes are taken.—"The Genus *Coprosma* as a Source of Dyes," by B. C. Aston, F.I.C., in the New Zealand Journal of Science and Technology, vol. i., No. 5, 1918, pp. 264-267.

Brimstone Tree of Sierra Leone.—In the *Kew Bulletin* for 1916, pp. 8-16, figs 1-4, the writer gave an account of the "Brimstone Bushes" of Tropical West Africa, which name is applied to certain species of *Morinda* (*Rubiaceae*). According

to Mr. C. E. Lane-Poole, at that time Conservator of Forests in Sierra Leone, there is another plant, belonging to a different genus of the same family, which is called the "Brimstone Tree." This is *Mitragyne stipulosa*, O. Ktze. (*Mitragyne macrophylla*, Hiern). Mr. Lane-Poole supplied the following information:—

"The Brimstone tree: A very large forest tree, without buttress roots, growing to a height of 150 ft., and a diameter of over 6 ft. at the base. The bole is straight and generally 40 to 50 ft. to the first branch. The bark is grey, rough, and stringy. It yields a very durable, useful timber; floors built of this may be seen in Freetown up to 100 years old. Practically all the weather-boarding of the wooden Creole houses of Freetown consists of Brimstone. It is of a yellow colour when freshly sawn, but turns much browner with age. The natives in the Protectorate use it for every purpose where sound, durable wood is required. It is not attacked by termites, longicorns, scolitides, or other borers. Young saplings are preferred to any other for rafters in native thatched houses. The ridge pole is generally made of one sapling of this species. The canoe-shaped receptacle used for standing palm-oil in, the wooden platters, the rice mortars, and a number of similar articles, are made of this wood. A decoction of the bark is used to cure malaria, and natives, footsore by long marching, bathe their feet in water in which the bark has been boiled. Mendi name: *Bundui*. Creole name: Brimstone tree. It flowers at the end of April and beginning of May for a few days only."

Mitragyne stipulosa was first described as *Nauclea stipulosa* by De Candolle (Prodr. iv. 346) in 1830, from specimens collected by Leprieur on the banks of the Gambia River. The species is now known to occur in nearly the whole of the forest area of Tropical Africa, from Gambia to Angola (*Welwitsch*), through the Shari region to the Bahr el Ghazal and Uganda, southwards to the Zambesi (*Kirk*). In regard to Mr. Lane-Poole's statement on the use of this plant in Sierra Leone as a remedy for malaria, it is interesting to find a note to the same effect by Kirk, who collected a specimen near Sena, on the Zambesi, in December, 1860.

Accompanying another gathering by Mr. Lane-Poole (No. 214) in Sierra Leone, is a note saying that the leaves of this tree are the only ones used to wrap up Kola nuts, and the same use for them is noted by Mr. Scott-Elliot (No. 5014). According to Mr. H. J. Sankey, Conservator of Forests, Southern Nigeria, the tree is "common along river banks and in swamps in Ordo forests; used for canoes, but not durable; an easily worked, fine-grained, light-brown wood which floats." For further information regarding this tree, see *Kew Bulletin*, Add. Ser. ix. p. 345 (*M. macrophylla*). J. H.

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JUL 21 1918

ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 3] [1919

III.—CONTRIBUTIONS TO THE FLORA OF MACEDONIA: II.

W. B. Turrill.

A small parcel of plants collected by Sergt. J. M. Russell in the Paprat District, Krusa Balkan, Central Greek Macedonia, arrived too late for inclusion in the first paper of this series (*Kew Bulletin*, 1918, p. 249), and is dealt with here. The list given below is chiefly of interest in adding considerably to the number of plants recorded in flower in July and August. As previously explained (l.c., p. 259), the vegetation in mid-summer "becomes scorched to a straw or pale-brown colour, and with few exceptions other than xerophytic plants, green vegetation and flowering specimens are limited to specially protected localities such as nullahs." Most of the specimens recorded in this paper are remnants of the earlier summer flora. The Paprat District abounds in shady and shrubby ravines, and though on a southern slope may be considered a favourable locality for summer flowers, at least, when compared with the dry hill-slopes immediately to the north of Salonika or the exposed plains of the larger rivers.

The collection is divided into two parts. The first consists of specimens collected during the last week in July and the first week in August, 1918. The second contains the plants found in the last week in August, 1918. Unless otherwise stated the specimens were collected in the flowering state. Species recorded in the previous paper are in *italics*, those recorded for the first time in this series are in clarendon type.

Plants Collected During the Last Week in July and the First Week in August, 1918.

Thalictrum angustifolium, Jacq. *Russell* 123.
Nigella arvensis, L. *Russell* 118.
Viola Kitaibeliana, R. et S. *Russell* 117.
Silene trinervia, Seb. et Maur. *Russell* 108.
Saponaria officinalis, L. *Russell* 106.

(282.) Wt. 158—829. 1,125. 5/19. J. T. & S., Ltd. G. 14. Sch. 12.

Malachium aquaticum, *Fr.*
Russell 115.
Distr. Eur., Orient, Temp. Asia, India.
Balkans: Greece, Maced., Serb., Bulg.

Cytisus austriacus, L. *Russell* 104a.
Ononis antiquorum, L. *Russell* 107.
Medicago falcata, L. *Russell* 102, 130.

Lotus decumbens, *Poir.*
Russell 104.
Distr. S. Eur.
Balkans: Greece.

Epilobium parviflorum, Schreb. In flower and fruit, *Russell* 112.

Herniaria hirsuta, *L.*
In flower and fruit, *Russell* 128.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Scleranthus perennis, L. In flower and fruit, *Russell* 96.

Torilis infesta, *Hoffm.*
Russell 110.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Sambucus Ebulus, L. *Russell* 124.

Galium Aparine, *L.*
In fruit, *Russell* 100.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: General.

Anthemis tinctoria, L. *Russell* 98.
Achillea clypeolata, Sm. *Russell* 121.
Filago arvensis, L. *Russell* 126.
Inula britannica, L. *Russell* 127.
A form with very silky leaves and aggregated capitula.
Xeranthemum annuum, L. *Russell* 113.
Centaurea salonitana, Vis. *Russell* 105.
Campanula Spruneriana, Hmpe., var. *lepidota,* Turrill. *Russell* 95.
Campanula athoa, Boiss. *Russell* 134.
Jasione Heldreichii, Boiss. et Orph. *Russell* 111, 120.

Cynoglossum nebrodense, *Guss.*
Russell 132.
Distr. S. Eur.
Balkans: Greece, Bulg.

Echium vulgare, L. *Russell* 103.
Solanum Dulcamara, L. *Russell* 116.
Linaria genistaefolia, Mill. *Russell* 131.
Veronica Velenovskyi, Uechtr. In flower and fruit, *Russell* 114.

A species related to *V. Anagallis* and *V. Beccabunga* but characterised by the slender pedicels, which are 3 to 5 times as long as the subtending bracts, the narrower, linear-lanceolate calyx segments, and the small seeds.

Teucrium Chamaedrys, L. *Russell* 122.

Salvia verticillata, *L.*
Russell 97.
Distr. Cent. and S. Sur., Orient.
Balkans: General.

Stachys angustifolia, M.B. *Russell* 133.
Origanum vulgare, L. *Russell* 125.
Rumex multifidus, L. *Russell* 129.

Juncus effusus, *L.* var. **compactus,** *Lej. et Court.*
Russell 99.
Distr. Most temperate countries.
Balkans: General.

Poa compressa, *L.*
Russell 101.
Distr. W., Cent. and S. Eur., N. Asia, N. Amer.
Balkans: Thessaly, Serb., Bulg.

Collected During the Last Week in August, 1918.

Hypericum perforatum, L. *Russell* 150.
Ononis antiquorum, L. *Russell* 144.
Dorycnium intermedium, Ledeb. *Russell* 141.
Scabiosa ucranica, L. *Russell* 151.
Anthemis tinctoria, L. *Russell* 140.
Achillea crithmifolia, W. K. *Russell* 139.
Inula britannica, L. *Russell* 149.

Carlina vulgaris, L.
Russell 143.
Distr. Eur., Orient.
Balkans: General.

Xeranthemum annuum, L. *Russell* 138.
Centaurea sublanata, Boiss. *Russell* 135.
Campanula athoa, Boiss. *Russell* 136.
A form with calyx segments and receptacles much less strigose, with fewer stiffer hairs than in *Russeli* 134, and the typical plant. The plants quoted by Velenovsky (Flora Bulgarica, p. 368), under the name *C. Trachelium*, L., var. *orientalis*, Boiss., belong to this species, and Bulgaria must be added to the distribution given for *C. athoa*, Boiss., in *Kew Bulletin*, 1918, p. 306.

Verbascum banaticum, *Rosc. ap. Schrad.*
Russell 142.
Distr. Hungary, Epirus, Thessaly, Maced., Serb., Dobrudgea, Bulg.

Salvia verticillata, *L.*
Russell 145.
Distr. Cent. and S. Eur., Orient.
Balkans: General.
A form with the leaves white tomentose on the lower surfaces.

Calamintha vulgare, *L.* forma **glabratum,** *Vandas,* Reliq. Formanek., p. 478.
Russell 137.
Distr. (of form) Maced.
Origanum vulgare, L. *Russell* 148.
Thymus Chaubardii, Boiss. et Heldr. *Russell* 146.

Agrostis stolonifera, *L.* (*A. alba,* Auct.).
In fruit, *Russell* 147.
Distr. Eur., Temp. Asia, N. Afr., N. Amer.
Balkans: General.

IV.—FLORA OF ALDABRA: WITH NOTES ON THE FLORA OF THE NEIGHBOURING ISLANDS.

W. Botting Hemsley and others.

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Introduction.

Description of the Atoll.

Aldabra, or Aldabra Group as it is sometimes designated, is an atoll in the Indian Ocean, situated, according to the authorities, 220 miles north-west of Madagascar, in latitude 9° 25′ south. The ring of land surrounding the lagoon is about

twenty-two miles long by eight miles in its greatest breadth, oblong-oval in outline, and with its longer axis lying east and west. The land-rim is broken up into four islands of odd shapes, very unequal in size, the main island surrounding at least two-thirds of the lagoon. Within the lagoon there are several islands of relatively large area and hundreds of small islets varying in size from a few acres to a few square yards. The inner or lagoon shore of the land-rim is everywhere bounded by mangrove swamps, intersected by numerous channels. In length the lagoon is about twenty miles with a width of six miles, and it is connected with the open sea by four channels, the largest of which is four hundred yards wide and eight to ten fathoms deep, and the only one deep enough to allow of the passage of a large vessel. Mr. J. C. F. Fryer describes in some detail the topography, physical features, etc., of Aldabra, and it will be sufficient for the purposes of this paper to give a short extract from his work concerning the islands which he designates the Aldabra series. "It contains the islands of Aldabra, Assumption, Cosmoledo, Astove, Farquhar, Providence and St. Pierre. The whole series lies to the north of Madagascar, between longitudes 45° E. and 52° E., and between latitudes 9° S. and 10·5° S., the component islands being separated from 20 miles—Aldabra and Assumption—to 180 miles —Astove and Farquhar."

For purposes of comparison I have also summarised very briefly what is known to me of the botany of Gloriosa, the Amirantes group. Coëtivy, Agalega, Cargados, the Laccadives, Maldives, and the Chagos Archipelago.

Climate.

There are few statistics of the meteorology of Aldabra, but there are sufficient data to establish the fact that its climate is one of extremes of drought and rainfall. Writers differ widely in their estimate of its qualities. Professor Stanley Gardiner, writing of Mr. Fryer's stay in the island (September to the end of January), says: "His work during this, the summer season at Aldabra, must have been, as we know by our own experience elsewhere, arduous in the extreme on an island of jagged coral, covered with the hard-wooded *Pemphis acidula*, through which all paths had to be cut, and having in the centre a stinking mangrove swamp literally alive with mosquitoes. Even native labour dislikes going to Aldabra, which has an evil reputation second to none in the world."

Voeltzkow, as quoted by Schinz, says: "Aldabra lies within the range of the trade winds and has an agreeable climate, as the cool sea winds temper the great heat. The average temperature at mid-day, from the middle of April to the middle of May, is 85° to 86° Fahr. with a nightly fall of about 10°. The rainy season begins in December, but showers are frequent even in May. The dry season begins towards the month of July."

Mr. Dupont records a series of observations of temperature and rainfall from October to January. He states that the climate of Aldabra is much warmer than that of Mahé, and

gives figures for the months named in support of this statement. Daily readings at 9 a.m. recorded an approximate average of 89·8° for Aldabra, against 82·4° for Mahé. The rainfall for the same period was respectively about 34 in. and 49 in. Dupont adds: "The dry season of Aldabra occupies seven months of the year, and the absence of rain is the cause of much trouble to the inhabitants who neglect to store sufficient to provide against the drought. There is only one well in the island, 16 miles distant from the settlement, and the water has to be fetched by boat." The heaviest rainfall in both islands was in January, when upwards of 25 in. fell in 17 days in Aldabra and 21 in Mahé.

The Flowering Season.

Concerning the flowering season in Aldabra, Mr. Dupont wrote: "An old resident told me that in January to May the whole island is a mass of flowering shrubs and herbaceous plants, and that nowhere in Seychelles such a display of wild flowers with its accompaniment of insects and birds is to be seen."

History of the Botanical Investigation of Aldabra.

The history of the botanical exploration of Aldabra begins, so far as this compilation is concerned, with Dr. W. L. Abbott's Notes on the Natural History of the Atoll in the *Kew Bulletin* for 1893, in which he specially mentions thickets of *Casuarina*, and mangroves 50 to 60 ft. high. Further particulars by the same author appeared elsewhere and Mr. Dupont repeats them in his report, published in 1907. From this source I have extracted much that is of interest in connection with the vegetation of Aldabra and other islands. Abbott's notes were followed in 1894 by Mr. J. G. Baker's report on Abbott's botanical collection. This collection comprised fifty-two species of flowering plants, including nine new ones. Noteworthy among the older forms was *Lomatophyllum borbonicum*, a liliaceous genus of two or three species restricted to the Mascarenes and the smaller islands of the western Indian Ocean, though hitherto not recorded from Seychelles.

In point of date Mr. S. C. E. Baty, a local owner or joint owner of insular property, is the next contributor, in the form of an unpublished report on the Aldabra and Cosmoledo groups of islands, a copy of which is in the Kew Library. This report is mainly on the coco-nut industry and the useful trees, with some topographical notes. He mentions, too, that Aldabra was covered with stunted forest from end to end; that some 350 coco-nut trees had been planted, and that Coco-nut Islands at the east end of the lagoon had a small grove of coco-nut trees and some fine Casuarinas.

During the years 1889 to 1895, Dr. A. Voeltzkow, a professor of zoology, travelled in Africa and Madagascar and likewise visited Aldabra, where he made a small herbarium. This was classified and the results published in 1897 by Dr. Hans Schinz, who also incorporated Abbott's plants in his enumeration. A few pages of introduction treat of the topography and local conditions,

supplied by Voeltzkow, and of the composition of the vegetation, by the author. The number of species of flowering plants was hereby increased from fifty-two to seventy-one, inclusive of one new species, *Grewia salicifolia*. I have not seen Voeltzkow's book, but a notice of it by Hahn in Peterman's Geographische Mitteilungen for 1898 conveys a false idea of the vegetation of Aldabra which is said to consist chiefly of *Rubiaceae*, *Tiliaceae*, *Leguminosae*, and especially of *Oleaceae*. *Rubiaceae* and *Leguminosae* are certainly dominating families; but the *Tiliaceae* are represented by the genus *Grewia* only, and *Jasminum aldabarense* is the sole member of the *Oleaceae* known to inhabit the island.

Mr. Dupont's help in the investigation of the Flora of Seychelles, Aldabra, and other coral islands of the western Indian Ocean, has been most valuable and continuous, beginning in 1905 and ending, so far, in 1916. His technical knowledge of plants enabled him to answer botanical questions, to which he always very promptly responded. His first communication concerning Aldabra plants is dated Dec. 7th, 1906, and included a list of dried specimens of upwards of a hundred species of plants collected by himself in the atoll, together with their local names, applications, etc. This was followed in 1907 by a most interesting and valuable report to the Governor of Seychelles. It is a mine of information, general and special, and is illustrated by charts of all the groups, except St. Pierre, and by a tabulated view of the distribution of the plants in the islands and in Madagascar and the Mascarenes. The section relating to Aldabra is much fuller than the others, especially on the vegetation, and, as the report exists in few libraries, some of the paragraphs are reproduced here in detail. Mangroves constitute the bulk and a predominating feature in the vegetation, and Dupont records particulars of the extent, composition and economic value of this element in the "forests," as he terms them. In his own words: "the lagoon is encircled on all sides by mangrove trees, which are visible from outside on spots where the ring of land is narrow. Most of the islets in the lagoon are also covered with the same trees. The contrast between them and the scrubby ring of land is striking. As the ring of land is about thirty-nine miles long, the dimensions of the forest may be put down as 3000 acres. The forest is not of uniform width, some places being destitute of trees and others possessing forests which extend alongside channels as far as one mile inland. On Ile Picard and Middle Island I have come across lofty trees over 60 ft. high and over 1 ft. in diameter. Towards the south very fine clumps are also to be seen, but the forest in this part is not in a very healthy condition."

He enumerates eight species of mangrove under their botanical and popular names, and groups them in two sets, as follows:—

I. Mangroves constituting the bulk of the forests.

Rhizophora mucronata—Manglier Hauban. *Rhizophoraceae*.
Bruguiera gymnorhiza—Grand Manglier Rouge. ,,
Ceriops Candolleana—Manglier Jaune. ,,

Avicennia marina—Manglier Blanc. *Verbenaceae.*

II. Mangroves which exist in isolated patches only, except on Ile Esprit, where seven out of the eight species grow within fifty yards.

Carapa moluccensis—Manglier Pomme. *Meliaceae.*
,, *obovata*—Petit Manglier Pomme. ,,
Lumnitzera racemosa—Manglier Petites Feuilles. *Combretaceae.*
Sonneratia acida—Manglier Fleurs. *Lythraceae.*

The essence of Dupont's further remarks on the distribution of the mangroves is embodied in the following abridgment:

Lumnitzera was seen only at the south* end far inland, forming separate bushy groves. *Avicennia* occupies a large area on the same part to the exclusion of all the other mangroves. The three *Rhizophoraceae* are constantly mixed together; *Bruguiera* largely predominating almost everywhere, except in Picard Island, where *Rhizophora* is very abundant, and at the south-east and south corners, where *Ceriops* is much more abundant than elsewhere. The inter-distribution of these *Rhizophoraceae* warrants the idea of a struggle for life, in which *Bruguiera* and *Ceriops* are stronger by means of their buttresses and underground roots. For the same reason *Avicennia* is stronger than the *Rhizophoraceae*, the latter requiring situations unexposed to the tide. In Middle Island the trees of *Rhizophora* are not so tall as in Picard, but those of *Bruguiera*, which predominate, are splendid, and together with *Ceriops* cover extensive ground all along the lagoon, nine miles in length.

The forest of South Island covers an area of not less than 1300 acres, but the proportion of *Rhizophora* is only about 4 per cent.; the trees existing in isolated, though sometimes very tall and healthy, patches on the western side. In this eastern portion *Bruguiera* predominates in some places, *Ceriops* in others.

Dupont's Distribution Table of the Plants of Aldabra comprises about 100 species, and it shows their occurrence in Seychelles, Amirantes, Providence, St. Pierre, Astove. Cosmoledo, Assumption, Comoros, Gloriosa, Madagascar and the Mascarenes, so far as known to the author. It is not nearly so complete or correct as it might have been, because he could not delay the publication of his report until the names of those plants unknown to him could reach him from Kew. A considerable number of these plants were previously unknown at Kew, and are apparently endemic in Aldabra, though likely to occur in some of the other islands or in Madagascar.

From this table and other sources of information it is evident that the Flora of Aldabra differs from that of the other atolls or small islands named above of what may be termed the Seychelles area. It differs in being much richer in genera and species and in having a considerable endemic element, or at least an element

* This should read east end according to Dupont's chart, on which "White Mangrove" is indicated.—W. B. H.

apparently almost wholly absent from the other islands so far as investigations have hitherto been carried.

Mr. Fryer's report on Aldabra and neighbouring islands is a comprehensive one, dealing most fully with Aldabra, and containing many paragraphs of interest to the botanist, which are freely repeated here. It contains a chart of the atoll, and the illustrations of scenery give a good idea of its physical features and natural aspects. Fryer arrived at Aldabra on the 13th of September, 1908, and remained there until the 24th of January, 1909, so that he had opportunities for studying the fall and spring of vegetation. Concerning the name of the island, Fryer quotes Voeltzkow, that it is probably of Arabic origin, that it has undergone several modifications, and signifies "The Green," in reference to the dense vegetation. Passing to the section treating of the vegetation, it should be explained that the main topographical features of the atoll are: the land; the lagoon, comprising the lagoon shores—mangrove swamps—and channels to the sea; and the fringing reef and outer slope. In the author's own words: "The floral seasons actually coincide with the climatic. The season of south-east trades is generally a season of drought and rest, and many of the trees being leafless, all forms of bush have then an extremely barren and dead appearance. At the end of October signs of renewed life are visible, and after the first rains in November many plants begin to flower, often before their leaves have appeared. In December and January the remainder of the plants are in flower, with the exception of a few, which by their condition suggest that they flowered quite at the end of the season. There are roughly four types of vegetation corresponding to four different classes of situation. These are: 1. Mangrove Swamp; 2. Pemphis Bush; 3. Varied or Open Bush; and 4. Shore Zone.

The mangrove swamp fringes the lagoon, but is also found on the seaward coast of the atoll at Camp Frigate and on Magnan Island in the western channel, where it is protected from the direct force of the waves. It is composed of true mangroves—*Rhizophoraceae*; the genera being *Rhizophora*, *Bruguiera* and *Ceriops*. *Rhizophora mucronata* is uniformly scattered through almost every part of the swamp, and also forms forests in one or two places, notably Picard and Camp Frigate, which contain few trees of other species. The genus *Bruguiera* is represented by two species, *B. gymnorhiza*, and another not yet determined,* which together form a large proportion of the forest along Malabar and Main Islands and especially to the south of Michel Island. It is the largest tree on Aldabra and reaches a height of 60-70 ft. Of the genus *Ceriops* there are apparently three species, *C. Candolleana* and two others. On Aldabra it is an uncommon genus and is most prevalent at Lance Cavallier,

* Mr. Fryer hoped to be able to publish the grounds on which he formed the opinion that he had to do with two species of *Bruguiera* and three of *Ceriops*. Other writers have expressed similar convictions, and there may be differential characters which are not evident in dried and spirit-preserved specimens. At all events, I recognised only one species of *Bruguiera* and one of *Ceriops* in the material collected by Fryer, and now I am unable to re-examine it.—W. B. H.

south of Esprit Island, on Esprit itself and on the Main Island north-east of Michel. Both *Bruguiera* and *Ceriops* do not require much mud and are tolerant of a rocky situation, and one which the tide reaches but for a short period.

Of other mangrove swamp trees there are five genera, the most prevalent being *Avicennia marina*, which is found all round the lagoon between tide-marks, especially in sandy places. It also forms a large forest in the extreme east of the atoll, where the trees attain a large size. *Sonneratia acida* is decidedly scarce and occurs only on Esprit and Picard Islands. *Carapa obovata* and *C. moluccensis* are both found on Esprit Island, and the latter on Picard and on one of the islands in the western channels. At Esprit a small forest is formed by *C. moluccensis* between the ridge of rock previously described and the true mangrove swamp.

2. The Pemphis Bush is composed almost entirely of *Pemphis acidula*, and is found in conjunction with the metamorphosed limestone.

3. Open Bush occurs in the neighbourhood of Takamaka, and extends round the atoll, eastward as far as a line drawn from Michel Island to Hodoul Point. To the westward it extends nearly to Dunes Jean Louis; but in this direction it is much reduced in size by the shore-zone passing far inland. Plain Cabris on Picard Island also supports the same type of vegetation. The vegetation consists mostly of low trees and bushes. Herbaceous plants are scarce, and are only found in the wet season, when a few sedges and grasses occur in places. The bushes and trees are usually leafless, or partially so, in the dry season, and flower at the commencement of the rains, often before the leaves appear. Almost all the Aldabra plants are to be found in this type of country. A few that are easily recognised are: *Euphorbia Abbottii*, various species of *Ficus*, two species of *Grewia*, and several *Leguminosae*. Large clumps of *Pandanus Vandermeeschii* are very frequent, but the majority of plants were not identified in the field.

4. The Shore Zone extends all round the atoll, varying much in width. It owes its existence to a little soil formed of sand blown up from the reef, and is naturally therefore widest on the south-east coast. Characteristic plants are *Scaevola Koenigii*, *Tournefortia argentea*, and in places *Cordia subcordata*."

Mr. Walter Fox, late Superintendent of the Botanic Garden at Penang, visited Seychelles, Aldabra, and Assumption in 1916, and made a considerable collection of dried plants, which he presented to Kew. This collection, named by the Kew Staff, contained a number of plants not previously reported from the islands, and these have been incorporated in this paper, and the collector's name appended in each case.

My thanks are due to the Council of the Linnean Society for presentation copies of Professor Stanley Gardiner's narrative of the history, equipment, and work of the Expedition. I am also greatly indebted to Sir David Prain and the Herbarium

Staff at Kew for active assistance in carrying on and completing this work after I had left the neighbourhood of Kew. Almost every member of the Staff has helped me in some way, and Dr. Stapf and Messrs. W. B. Turrill, C. H. Wright, and J. Hutchinson worked out certain families to which their names are appended, while Mr. S. A. Skan has been most kind in answering chiefly literary queries. For their valuable support I have much pleasure in recording my gratitude.

Some explanation of the late appearance of this small contribution to phytogeography is due to Professor Stanley Gardiner and other members of the Expedition, and to Mr. Dupont and the Hon. H. P. Thomasset, all of whom have worked most assiduously in collecting materials for the work. The explanation of the delay, which I greatly regret, is that a combination of circumstances—other work of a more imperative character, less working capacity, and duty calls on my time—has prevented me from pursuing a labour of love.

The projected Flora of Seychelles, although well advanced, must perforce still remain in abeyance. All of the leading novelties from this archipelago have been published; partly in the *Kew Bulletin* and Hooker's Icones Plantarum; partly in the Journal of Botany. Many almost extinct plants and other imperfectly known plants have thus been placed on permanent record.

Systematic Enumeration of the Vascular Plants of Aldabra.

Under each species reference is given to Baker's Flora of Mauritius and Seychelles, when the species is contained in that work. For additional previously described species reference is given to a regional publication, such as the Flora of Tropical Africa, and for new species to the place of publication. Descriptions of most of the novelties have appeared in the Journal of Botany, 1916, Supplement ii., and 1917, pp. 285-288. Synonyms are cited only in cases where it seemed desirable for clearness. Some of the species admitted in this enumeration might with equal reasons perhaps have been included in the category of those owing their presence in Aldabra to the direct or indirect influence of man; but such species are left out of consideration in the discussion of the indigenous element.

Menispermaceae.

Cissampelos Pareira, *L.*, var **nephrophylla**, *Diels* in Engl. Pflanzenr., Menispermac., p. 292.

Fox 263.

Distr. The species generally dispersed in hot countries.

Capparidaceae.

Cleome strigosa, *Oliv.* Fl. Trop. Afr. i. p. 80; Baker in *Kew Bull.*, 1894, p. 146. *Polanisia strigosa*, Boj.; Schinz in Abhandl. Senckenb. xx. p. 84.

Abbott; *Thomasset* 236; *Fryer* 43.

Distr. East Africa. Also Astove, *Fryer* 10; Glorieuse (*Baker*).

Gynandropsis pentaphylla, *DC.*; Baker, Flora, p. 9.
Dupont 42.
Distr. Widely spread in warm countries, largely as a weed of cultivation.

Maerua Dupontii, *Hemsl.* in Journ. Bot. 1916, Suppl. ii. p. 2.
Fryer 64; *Dupont* 136, 137.
Distr. Endemic.

Maerua, cfr. **M. cylindrocarpa,** *Gilg & Bendict* in Engl. Jahrb., liii. p. 241.
Fox 270.

Maerua, cfr. **M. pubescens,** *Gilg* in Engl. Jahrb., xxxiii. p. 223.
Fox 260.

Capparis galeata, *Fresen.*; Oliv. Fl. Trop. Afr. i. p. 95; Baker in *Kew Bull.*, 1894, p. 146.
Abbott; *Dupont* 5, 21; *Fryer* 20.
Distr. Tropical Africa and Asia. Astove, *Fryer* 5.

Bixaceae.

Flacourtia Ramontchii, *L'Herit.*; Baker, Flora, p. 12.
Dupont 57, 94; *Fryer* 35; *Fox* 244.
Distr. Common in the tropics of the Old World; often planted.

Portulacaceae.

Portulaca quadrifida, *L.*; Baker, Flora, p. 125; *Kew Bull.*, 1894, p. 147.
Abbott, *Fox* 216; *Dupont* 60; *Fryer* 104; *Thomasset* 214.
Distr. Widely spread in the tropics, especially in maritime districts. Assumption, Astove, *Thomasset*.

Guttiferae.

Calophyllum Inophyllum, *L.*; Baker, Flora, p. 16.
Dupont 128; *Fryer* 55.
Distr. A common sea-shore tree in Asia and Polynesia.

Malvaceae.

Sida spinosa, *L.*; Baker, Flora, p. 20; Schinz in Abhandl. Senckenb. xii. p. 87.
Fox 264; *Fryer* 107; *Dupont* 119; *Thomasset* 238.
Distr. Very widely spread in the tropics.

Sida carpiniifolia, *L. f.*; Baker, Flora, p. 20.
Fox 286.
Distr. General in the tropics.

Abutilon asiaticum, *G. Don*; Baker, Flora, p. 21.
Dupont.
Distr. Tropics of both hemispheres; often naturalised.

Abutilon sp., an **A. angulosum,** *Bojer*, in Herb. Kew ?; Hemsl. in Journ. Bot. 1916, Suppl. ii. p. 4 (description). *Abutilon indicum*, Baker in *Kew Bull.*, 1894, p. 147, non L.
Abbott; *Dupont* 58; *Thomasset* 226.
Thomasset's specimens are labelled Astove, Cosmoledo and Aldabra.

Thespesia populnea, *Corr.*; Baker, Flora, p. 25.
Fryer 83.
Distr. Widely spread in maritime districts in the tropics of the Old World and general in Polynesia from Easter Island westward.

Tiliaceae.

Grewia aldabrensis, *Baker* in *Kew Bull.*, 1894, p. 147.
Abbott; *Dupont* 54; *Fox* 208; *Fryer* 58, 73; *Thomasset* 258.
Distr. Endemic.

Grewia salicifolia, *Schinz* in Abhandl. Senckenb. xxi. p. 87.
Fox 235; *Fryer* 88; *Voeltzkow.*
Distr. Endemic.

Erythroxylaceae.

Erythroxylon acranthum, *Hemsl.* in Journ. Bot., 1916, Suppl. II. p. 5.
Dupont 103; *Fox* 273; *Fryer* 35, 87; *Thomasset* 233.
Distr. Endemic.

Zygophyllaceae.

Tribulus cistoides, *L.*; Oliv. Fl. Trop. Afr., i. p. 284 (under *T. terrestris*); Schinz in Abhandl. Senckenb. xx. p. 85.
Voeltzkow.
Distr. Tropics generally, especially in maritime districts.

Tribulus terrestris, *L.*; Baker, Flora, p. 36; *Kew Bull.*, 1894, p. 147.
Abbott; *Dupont* 104; *Fryer* 102.
Distr. Very widely spread in the tropics.

Simarubaceae.

Suriana maritima, *L.*; Baker, Flora, p. 42; *Kew Bull.*, 1894, p. 147.
Abbott; *Dupont* 3; *Fox* 214.
Distr. One of the commonest seaside shrubs in the tropics of both hemispheres.

Meliaceae,

Carapa moluccensis, *Lam.*; Hemsl. in Journ. Bot. 1916, suppl. II. p. 7; Dupont Report, t. 24, non Baker, Flora, p. 46, in nota. *Trichilia* (?) Baker, Flora, p. 47, in nota.
Dupont; *Fryer.*
Distr. Tropical shores of East Africa, Asia, and Australia.

Carapa obovata, *Blume;* Hemsl. in Journ. Bot. 1916, Suppl. II, p. 7; Dupont Report, 1907, p. 24. *C. moluccensis,* Baker, Flora, p. 47, in nota, non Lam.
Dupont; Fryer 72.
Distr. Malaya.

Ochnaceae.

Ochna Fryeri, *Hemsl.* in Journ, Bot., 1916, Suppl. II. p. 7. *O. ciliata,* Baker in *Kew Bull.*, 1894, p. 147, vix Lam.
Abbott; *Dupont* 1; *Fryer* 32.
Distr. Endemic.

Ochna mauritiana, *Lam.*; Baker, Flora, p. 43.
Dupont 5.
Distr. Mauritius.

Icacinaceae.

Apodytes mauritiana, *Planch.*; Baker, Flora, p. 48; Hemsl. in Journ. Bot. 1916, Suppl. II. p. 8 (descriptio amplificata).
Fox 280; *Fryer* 62; *Thomasset* 225.
Distr. Mauritius.

Celastraceae.

Celastrus senegalensis, *Lam.;* sensu Oliv. Flora Trop. Afr. i. p. 361; Hemsl. in Journ. Bot. 1916, Suppl. II. p. 8, ubi vide formas 3 descriptas. *Gymnosporia senegalensis,* Loes., var. *inermis,* Loes., forma *β chartacea,* Loes.
Dupont 19, 41, 49, 95, 101; *Fryer* 11, 57; *Thomasset* 234, 245, 246, 256; *Fox* 209; *Voeltzkow* 18.
Distr. Widely spread in Africa, both tropical and extra-tropical, and the Mediterranean region, eastward to India.

Elaeodendron sp.
Fox 212.
Distr. Elaeodendron is a considerable genus, common in the tropics of both hemispheres, including Mauritius.

Rhamnaceae.

Scutia Commersonii, *Brong.;* Baker, Flora, p. 51; *Kew Bull.*, 1894, p. 147.
Dupont 6, 37, 139; *Fox* 213; *Fryer* 40; *Thomasset* 232.
Distr. South Africa; Mascarene Islands; tropical Asia.

Colubrina asiatica, *L.;* Baker, Flora, p. 52; Hemsl. in Oliv. Flora Trop. Africa, i. p. 383.
Fryer 34, 90.
Distr. East Africa; Mascarene Islands; Tropical Asia, Australia, and Polynesia.

Gouania Retinaria, *DC.;* Balf. fil., Fl. Rodriguez, Reprint p. 34; Hemsl. in Journ. Bot. 1916, Suppl. II. p. 10. *G. tiliaefolia,* Baker, Flora, p. 52, pro parte.
Dupont 12, 129; *Fryer* 76; *Thomasset* 231.
Distr. Mascarene Islands.

Gouania tiliaefolia, *Lam.*; Baker, Flora, p. 52, pro parte; Balf. fil., Fl. Rodriguez, Reprint, p. 34; Schinz in Abhandl. Senckenb. xxi. p. 86; Hemsl. in Journ. Bot. 1916, Suppl. II. p. 10.
Abbott; *Voeltzkow.*
Distr. Mascarene Islands.
There is a little doubt about this being the genuine *G. tiliaefolia* of Lamark.

Sapindaceae.

Allophylus racemosus, *Radlk. Schmidelia racemosa,* L.; Baker, Flora, p. 56.
Fox 271.
Distr. Madagascar, Seychelles, Mascarenes and Tropical Asia.

Allophylus africanus, *Palisot;* Baker in *Kew Bull.*, 1894, p. 147 (sub *Schmidelia*). *Schmidelia africana,* DC.; Baker in Oliv. Fl. Trop. Africa, i., p. 421.
Abbott; *Fryer* 63.
Distr. Tropical Africa.

Macphersonia madagascariensis, *Blume*; Radlk. in Sitzungsb. K. Baier. Akad. 1890, p. 248. *Macphersonia pteridophylla,* Baill., Adansonia, xi. p. 240. *Albizzia fastigiata,* Mey. ? Baker in *Kew Bull.*, 1894, p. 148—Leaves only; Dupont, Report, p. 36.
Abbott; *Dupont* 28.
Distr. Madagascar. Dupont also collected it in Cosmoledo.
There are three very closely allied species of *Macphersonia,* namely, the above and *M. laevis,* and *M. Hildebrandtii,* Radlk., loc. cit., and I am not quite sure that I am right in referring the Aldabra specimens to *M. madagascariensis.*

Anacardiaceae.

Odina Woodier, *Roxb.* ? Thwaites, Enum. Ceylon Pl. p. 78.
Dupont 9. Leafless specimen in fruit.
Distr. The genus *Odina* is common to tropical Africa and Asia.

Moringaceae.

Moringa pterygosperma, *Gaertn.;* Baker, Flora, p. 9; Schinz in Abhandl. Senckenb. xxi. p. 84.
Voeltzkow, 5a, 61.
Distr. Tropical Asia and naturalised here and there in hot countries.

Leguminosae—Papilionatae.

Tephrosia aldabrensis, *J. R. Drumm. & Hemsl.* in Journ. Bot. 1916, Suppl. II. p. 11. *T. purpurea,* Baker in *Kew Bull.* 1894, p. 147, non Pers.
Abbott; *Dupont*; *Fryer* 59; *Thomasset* 230.
Distr. Endemic.

Abrus precatorius, *L.;* Baker, Flora, p. 78; *Kew Bull.* 1894, p. 147; Schinz in Abhandl. Senckenb. xxi. p. 85.
Abbott; *Fryer* 81; *Voeltzkow.*
Distr. Now very generally dispersed in tropical and some sub-tropical countries. Rare in coral islands.

Sophora tomentosa, *L.*; Baker in Oliver Fl. Trop. Afr., ii., p. 254; Hemsl. Bot. Chall. Exped. i. pt. I. p. 30; pt. III. p. 144.
Fox 262; *Thomasset* 221.
Distr. Generally diffused on tropical sea-shores and extending to some extra-tropical regions.

Leguminosae—Caesalpinioideae.

Caesalpinia Bonducella, *Fleming*; Baker, Flora, p. 88.
Thomasset 228.
Distr. Widely spread in the tropics of both hemispheres.

Caesalpina sepiaria, Roxb.; Baker, Flora, p. 88; Dupont, Report, 1907, p. 36.
Dupont.
Distr. Tropical Asia. Baker regards all the members of this genus in the Mascarene region as introduced; but it is probable that they owe their presence to the action of currents.

Cassia aldabrensis, *Hemsl.* in Journ. Bot. 1916, Suppl. II. p. 12.
Dupont 123; *Thomasset* 231, 262.
Distr. Endemic.

Cassia mimosoides, *L.;* Baker, Flora, p. 90; *Kew Bull.* 1894, p. 147; Schinz in Abhandl. Senckenb. xxi., p. 85.
Abbott; *Fox* 236; *Voeltzkow.*
Distr. Common in the tropics of both hemispheres.

Cassia occidentalis, *L.;* Baker, Flora, p. 89; *Kew Bull.* 1894, p. 147; Schinz in Abhandl. Senckenb. xxi., p. 85.
Distr. Now widely dispersed in Tropical Africa and Asia, as well as in America, though possibly of American origin.

Tamarindus indica, *L.*; Baker, Flora, p. 91; Balfour, Bot. Rodriguez, p. 37; Dupont, Report, p. 14, in map; Prain in Journ. As. Soc. Bengal, lx. p. 312.
Dupont; *Fryer* 94. Probably introduced in Aldabra.
Distr. Now common in Tropical Africa and Asia, extending to North Australia. Introduced in America. Commonly cultivated.

Leguminosae—Mimosoideae.

Pithecolobium ambiguum, *Hemsl.* in Journ. Bot. 1916, Supl. II. p. 13.
Fryer 39.
Distr. Endemic.

Gagnebina tamariscina, *DC.*; Baker, Flora, p. 91.
Fryer 117; *Dupont* 46; *Thomasset* 233.
Distr. "Very common, and also in Cosmoledo" *Thomasset.* Mauritius and Madagascar.

Desmanthus Commersonianus, *Baill.*, Atlas Pl. Madag. t. 23; Baker in *Kew Bull.* 1894, p. 148; Schinz in Abhandl. Senckenb. xxi. p. 84; Dupont, Report, p. 36.
Abbott; *Dupont*; *Voeltzkow.*
Distr. Madagascar.
[*Brexia madagascariensis*, Thouars, a characteristic shrub in Seychelles, and also found in Madagascar and East Tropical Africa, is not recorded from Aldabra; but the *B. spinosa* of Lindley, generally regarded as a variety of *B. madagascariensis*, is reported from St. Pierre.]

Rhizophoraceae.

Rhizophora mucronata, *Lam.*: Baker, Flora, p. 109; *Kew Bull.* 1894. p. 140; Dupont, Report, 1907, pp. 23-28.
Dupont; *Fryer* 2.
Distr. East Africa, Madagascar, Tropical Asia, Australia, and western Polynesia.

Bruguiera gymnorhiza, *Lam.*; Baker, Flora p. 110; Dupont, Report, 1907, p. 24.
Dupont; *Fryer* 15, 37.
Distr. Muddy shores of the tropics of the Old World.
The commonest of the true Mangroves in Aldabra, having about a 2000 acreage, according to Dupont.

Ceriops Candolleana, *Arn.*; Baker, Flora, p. 109; Dupont, Report, 1907, pp. 23, 28; Bentham, Fl. Austral. ii. p. 494.
Fox 228; *Fryer* 36, 82.
Distr. Muddy shores of the tropics of the Old World.
Next to the commonest of the *Rhizophoraceae*, estimated to cover 625 acres, *Dupont.*

Weihea Thomassetii, *Hemsl.* in Journ. Bot. 1916, Suppl II. p. 14.
Thomasset 224.
Distr.
Also from Nossi Bé, *J. M. Hildebrandt* 3202.

Combretaceae.

Terminalia Fatraea, *DC.* Prodr. iii. p. 12; Baker in *Kew Bull.*, 1894. p. 148; Schinz in Abhandl. Senckenb. xxi. p. 88.
Abbott; *Dupont* 78, 126; *Fox* 272; *Fryer* 45; *Thomasset* 235.
Distr. Common in Madagascar.

Lumnitzera racemosa, *Willd.*; Benth. Fl. Austral. ii. p. 504; Dupont, Report. p. 24.
Fryer 67.
Distr. Shores of Tropical Asia, including Ceylon, and also in Australia.

Lythraceae.

Pemphis acidula, *Forst.*; Baker, Flora, p. 101; *Kew Bull.* 1894, p. 148; Schinz in Abhandl. Senckenb. xxi. p. 88.
Dupont 4, 200; *Fryer* 95; *Thomasset* 217.
Distr. Sea-coast of E. Africa, Tropical Asia, Australia and Polynesia.
Thomasset notes that this is also common in Assumption, Astove, and Cosmoledo. Not known from Seychelles.

Sonneratia acida, *L.f.;* Baker, Flora, p. 102; Dupont, Report, 1907, p. 24.
Dupont 13; *Fryer* 70.
Distr. East Tropical Africa, Asia, and Australia.

Aizoaceae.

Mollugo Spergula, *L.*; Baker, Flora, p. 107.
Dupont 23, 206; *Fryer* 68.
Distr. Sandy seashores, tropics of the Old World.

Sesuvium Portulacastrum, *L.*; Baker, Flora p. 108; Balfour, Bot. Rodriguez, p. 43.
Fox 222; *Dupont* 92; *Fryer* 10.
Distr. Widely diffused on tropical and subtropical sandy seashores.

Rubiaceae.

Oldenlandia corymbosa, *Baker* in *Kew Bull.*, 1894, p. 148, and Schinz in Abhandl. Senckenb. xxi. p. 91 ? non L. Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 16, cum descriptione.*
Abbott. Dupont collected the same species in Assumption n. 108 and 108 bis.
Distr. Mascarenes.

Oldenlandia species nova ? Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 16, cum descriptione.
Thomasset 260.

Oldenlandia species ad huc indescripta ? Hemsl. in Journ. Bot., 1916, Suppl. ii., p. 17.
Fryer 46.

Tarenna nigrescens, *Hiern.* in Oliv. Fl. Trop. Afr. iii. p. 92, non Warb. in Engler Bot. Jahrb. xiii. p. 431; Hemsl. in Journ. Bot., 1916, Suppl. ii., p. 17. *Coptosperma nigrescens,* Hook. f. in Benth. et Hook. f. Gen. Pl. ii. p. 87. *Webera seychellensis,* Baker, Flora, p. 139.
Dupont 32; *Fryer* 98.
Distr. East Tropical Africa and Seychelles.

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* I have found it impossible to name the species of *Oldenlandia* satisfactorily without carrying my studies and investigations farther than circumstances permit.—W. B. H.

Tricalysia cuneifolia, *Baker* in *Kew Bull.* 1894, p. 148; Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 18 (descriptio ampliata).
Dupont 3, 132; Fryer 91.
Distr. Endemic.

Polysphaeria multiflora, *Hiern.* in Oliv. Fl. Trop. Afr. iii. p. 127.
Dupont 30, 86; *Fryer* 50; *Thomasset* 239.
Distr. East tropical Africa. Also from Assumption, *Dupont* 119.

Plectronia bibracteata, *Baker,* Flora, p. 146.
Dupont 204; *Fryer* 54, 74.
Distr. Seychelles and Mauritius.

Guettarda speciosa, *L.*; Baker, Flora, p. 143; Schinz in Adhandl. Senckenb. xxi. p. 9; Dupont, Report, 1907, p. 37.
Dupont; *Fox* 281; *Fryer* 51; *Voeltzkow.*
Distr. Widely spread on tropical shores, including Polynesia.

Pavetta trichantha, *Baker* in *Kew Bull.*, 1894, p. 148.
Abbott; *Dupont* 87; *Fryer* 86. Also in Assumption, *Dupont* 116.
Distr. Mascarenes.

Pavetta supra-axillaris, *Hemsl.* in Journ. Bot. 1916, Suppl. ii. p. 19.
Fryer, Ile Esprit, probably introduced.
Distr. Endemic.

Psychotria Pervillei, *Baker,* Flora, p. 155.
Fryer 56.
Distr. Seychelles.

Psychotria species indescripta ? (1) Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 19.
Dupont 24.

Psychotria species indescripta ? (2) Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 20.
Dupont 115.
A specimen, also in fruit only, in the Kew Herbarium, from Andrangaloaka, Central Madagascar, collected by G. W. Parker, is apparently the same as Dupont's n. 115.

Triainolepis Hildebrandtii, *Vatke* in Oesterr. Bot. Zeitschr. xxv. p. 230 (1875); Oliver Fl. Trop. Afr. iii. p. 219. *Psathura Fryeri,* Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 20.
Dupont 31, 44, 91; *Fox* 259, 284; *Fryer* 44; *Thomasset* 240.
Also in Cosmoledo, Thomasset 242, and Comoro Islands, Humboldt 47.
Distr. Zanzibar Island, North-West Madagascar.

Rutidea coriacea, *Baker,* Flora, p. 149.
Fox 279.
Distr. Mauritius, Bourbon.

Compositae.

Vernonia aldabrensis, *Hemsl.* in Journ. Bot., 1916, Suppl. ii. p. 20.
Fryer 41; *Fox* 283.
Distr. Endemic.

Psladia sp.?
Ile Miche.
Dupont 96; a shrub with yellow flowers.
A fragment bearing a few empty involucres.

Sonchus oleraceus, *L.*
Fox 215.
Distr. A cosmopolitan weed.

Launaea bellidifolia, *Cass.*; Oliver & Hiern. Fl. Trop. Afr., iii. p. 460. *Microrhynchus sarmentosus,* DC.; Baker, Flora., p. 181.
On the beach, *Dupont* 35.
Distr. Madagascar, Mascarene Islands, tropical Africa and Asia. Dupont collected this also in Assumption (112) and in Cosmoledo.

Goodeniaceae.

Scaevola Koenigii, *Vahl.*; Baker, Flora, p. 182, and in *Kew Bull.*, 1894, p. 148; Schinz in Abhandl. Senckenb. xxi. p. 91.
Dupont; *Fryer* 110.
Distr. A littoral shrub ranging widely from east Africa and Asia to Australia and Polynesia.

Plumbaginaceae.

Plumbago parvifolia, *Hemsl.* in Journ. Bot., 1916, p. 362.
Fryer 115.
Distr. Endemic.
It is possible that this may be a leafy condition of *P. aphylla,* Bojer, but it has a different aspect and the leaves are of a different shape and texture from those casually occurring on the barren stems of *P. aphylla.*

Plumbago aphylla, *Bojer*; Baker in *Kew Bull.*, 1894, p. 148; Schinz in Abhandl. Senckenb. xxi. p. 88; Dupont, Report, 1907, p. 37.
Dupont; *Thomasset* 257.
Distr. Dupont gives the following distribution of this singular plant: Astove, Cosmoledo, Assumption, Aldabra, Gloriosa. It is also abundant in Europa Island.

Sapotaceae.

Sideroxylon inerme, *L.*; Harv. Fl. Cap. iv. i. p. 438; Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 23. *Myrsine cryptophlebia*, Baker in *Kew Bull.*, 1894, p. 149; ex Mez in Engler Pflanzenr. Menispermac. p. 397; Schinz in Abhandl. Senckenb. xxi. p. 88.
Abbott; *Dupont* 7, 14, 106, 133; *Fryer* 38.
Distr. South Africa.

Sideroxylon sp., near **S. inerme,** *L.*
Fox 243.

Oleaceae.

Jasminum aldabrense, *Hemsl.* in Journ. Bot., 1916, Suppl. ii. p. 21. *J. mauritianum*, Baker in *Kew Bull.*, 1894, p. 149, non Bojer.
Abbott; *Fryer* 6, 21; *Thomasset* 247.
Distr. Endemic.

Salvadoraceae.

Azima tetracantha, *Lam.;* Harv. Fl. Capensis, iv. i. p. 489; Thwaites, Enum. Ceyl. Pl. p. 191.
Dupont 8, 27, 73.
Distr. Tropical and South Africa; Madagascar; Ceylon and Deccan Peninsula.

Salvadora angustifolia, *Turrill* in *Kew Bull.*, 1918, p. 232.
Dupont 15. Also from Cosmoledo, *Fox* 289.
Distr. Mascarenes.

Asclepiadaceae.

Microstephanus cernuus, *N.E.Br.* in *Kew Bull.*, 1895, p. 249; Hook. Ic. Pl. t. 2994. *Astephanus cernuus*, *A. ovatus* et *A. arenarius*, Decne.; DC. Prodr. viii. p. 507; Hemsl. in Journ. Bot., 1916, Suppl. ii. p. 21. *Astephanus arenarius*, Decne.; Baker in *Kew Bull.*, 1894, p. 149; Dupont, Report, 1907, p. 39.
Dupont 102, 130; *Fox* 249; *Fryer* 89, 97; *Thomasset* 215, 254.
Distr. East Tropical Africa; Madagascar.

Sarcostemma viminale, *R.Br.;* Baker, Flora, p. 227; *Kew Bull.*, 1894, p. 149; Schinz in Abhandl. Senckenb. xxi. p. 89.
Abbott; *Fryer* 93; *Voeltzkow.*
Distr. Tropical and South Africa and Mascarene Islands.

Secamone Fryeri, *Hemsl.* in Journ. Bot., 1916, Suppl. ii. p. 22.
Dupont 47; *Fryer* 61; *Thomasset* 225.
Mr. Dupont also collected this in Assumption, n. 115.
Distr. Assumption.

Tylophora asthmatica, *Wight & Arnott*; Baker, Flora, p. 229; Dupont, Report, 1907, p. 39.
Dupont 8.
Distr. Tropical Asia, including the Laccadives.

Borraginaceae.

Cordia subcordata, *Lam.*; Baker, Flora, p. 200; *Kew Bull.*, 1894, p. 149.

Abbott; *Fryer* 19; *Thomasset.*

Distr. A littoral tree widely spread in the tropics of the Old World and Polynesia.

Tournefortia argentea, *Linn. f.;* Baker, Flora, p. 20; Schinz in Abhandl. Senckenb. xxi. p. 90.

Fryer; *Thomasset*; *Voeltzkow.*

Distr. Mascarene Islands, Seychelles, Ceylon, Andamans, Malaya, Australia.

Convolvulaceae.

Ipomoea biloba, *Forsk.*; Baker, Flora, p. 211 (as *I. Pescaprae*). Schinz in Abhandl. Senckenb. xxi. p. 89; Dupont, Report, 1907, p. 38.

Fryer 111.

Also collected by Mr. Fryer in Astove, and Dupont records it from nearly all the islands of the region.

Distr. Generally spread on sandy shores in the tropics and extending into some sub-tropical regions. Also penetrating far inland in some countries.

Ipomoea (Calonyction) grandiflora, *Lam.;* Baker in *Kew Bull.*, 1894, p. 149; Schinz in Abhandl. Senckenb. xxi. p. 89. *Ipomoea glaberrima*, Bojer; Baker, Flora, p. 211.

Abbott; *Fryer* 112.

Distr. East Africa, Seychelles, Mascarenes, Polynesia.

Evolvulus alsinoides, *L.*; Baker in *Kew Bull.*, 1894, p. 149; Schinz in Abhandl. Senckenb. xxi. p. 89; Dupont, Report, 1907, p. 38.

Abbott; *Dupont* 50; *Fryer* 113; *Thomasset* 237.

Distr. Almost cosmopolitan in the tropics; often as a weed of cultivation,

Solanaceae.

Solanum aldabrense, *C. H. Wright* in *Kew Bull.*, 1894, p. 149; Schinz in Abhandl. Senckenb. xxi. p. 89; Dupont, Report, 1907, p. 38.

Abbott; *Fryer* 5; *Voeltzkow.*

Dupont records this from St. Pierre, Astove, Cosmoledo.

Distr. Mascarenes.

In general appearance this very strongly resembles the Madagascar *S. erythracanthus*, Bojer, but that has broader, distinctly veined corolla-lobes.

Solanum indicum, *L.*

Fox 282.

Distr. In all tropical regions.

Solanum nodiflorum, *Jacq.*; Baker, Flora, p. 214; Schinz in Abhandl. Senckenb. xxi. p. 90.
Voeltzkow.
Distr. Now generally dispersed in the tropics in cultivated and waste places.

Solanum nigrum, *L.*; Baker, Flora, p. 214; Dupont, Report, 1907, p. 38.
Dupont.
Dupont records this from all the islands.
Distr. An almost cosmopolitan weed.

Scrophulariaceae.

Herpestis Monnieria, *H.B.K.;* Baker, Flora, p. 237; Schinz in Abhandl. Senckenb. xxi. p. 90.
Dupont 87; *Fox* 275; *Fryer* 9.
Distr. Tropics of both hemispheres.

Acanthaceae.

Asystasia gangetica, *T. Anders.*; Baker, Flora, p. 247.
Dupont 61; *Fox* 232, 239.
Distr. Tropical Africa, Seychelles, India, Malaya.

Barleria sp., specimen mancum fructigerum.
Dupont 118.
Mr. Fryer collected the same plant in Astove.

Hypoestes aldabrensis, *Baker* in *Kew Bull.*, 1894, p. 150; Schinz in Abhandl. Senckenb. xxi. p. 90.
Abbott; *Dupont* 43; *Voeltzkow.*
Dupont describes this as a common weed with lilac flowers. He also collected it in Assumption, n. 101, and Fryer collected it in Astove, n. 7.

Hypoestes serpens, *R.Br.*, Baker, Flora, p. 248.
Fox, 251; *Fryer* 42, 101. *Thomasset* 264.
Distr. Mauritius, Madagascar.

Verbenaceae.

Nesogenes Dupontii, *Hemsl.* in Journ. Linn. Soc., Bot., xli., p. 314, pl. 14.
Fox 250; *Dupont* 97; *Thomasset* 261.
Distr. Assumption, *Dupont* 106.

Nesogenes species nova? Hemsl. in Journ. Linn. Soc., Bot., xli. p. 315.
Thomasset 236.

Nesogenes euphrasioides, *A. Gray,* the type species of the genus, inhabits islands of the Low Archipelago and Ducie Island, approximately between 120° and 150° west longitude, and between 15° and 20° south latitude. Two other species of the

genus are known, namely, *N. prostrata*, Hemsl. (*Radamaea prostrata*, Benth.) Agalega Islands, and *N. procumbens*, Balf. f., Rodriguez.]

Stachytarpheta indica, *Vahl.*; Baker, Flora, p. 251.
Fryer.
Distr. Now common in the tropics of both hemispheres.

Premna serratifolia, *L.*; Baker, Flora, p. 254, including *P. integrifolia*, L.
Dupont 120; *Fox* 247; *Fryer* 7.
Distr. East Africa, Seychelles, Mascarene Islands, Asia.

Clerodendron minutiflorum, *Baker* in *Kew Bull.*, 1894, p. 150.
Abbott; *Fryer* 77; *Thomasset* 251.
Dupont's n. 105 from Assumption Island is *Clerodendron minutiflorum.*
Distr. Assumption, Cosmoledo.

Avicennia marina, *Vierh.*; *A. officinalis*, Baker, Flora, p. 257; *Kew Bull.*, 1894, p. 50, not Linn. Dupont, Report, 1907, p. 24.
Dupont; *Fryer* 22.
Distr. Common on muddy shores of the Indian Ocean.
Dupont records this form Astove and Cosmoledo.

Labiatae.

Ocimum gratissimum, *L.*
Fox 219.
Introduced.
Distr. Tropical Asia and Africa.

Nyctaginaceae.

Boerhaavia diffusa, *L.*; Baker, Flora, p. 264; *Kew Bull.*, 1894, p. 150; Heimerl. in Abhandl. Senckenb. xxi. p. 83.
Dupont 9, 205.
Also Astove, Fryer 9.
Distr. Tropics of both hemispheres.

Boerhaavia repens, *L.*
Dupont 6, 122; *Fox* 278, 234; *Thomasset* 244.
Distr. Tropics.

Boerhaavia elegans, *Choisy.*
Fryer 80; *Thomasset* 235.
Distr. Tropical Africa and Asia.

Pisonia costata, *Choisy;* Baker, Flora, p. 263.
Dupont 51; *Fryer* 103.
Distr. Mauritius.
I am not quite sure about the specific identity of the Aldabra specimens with the type from Mauritius, the material being insufficient to decide the point.

Amarantaceae.

Deeringia celosioides, *R.Br.*; Wight, Icon. t. 728.
Fryer 85; *Fox* 207.
Distr. China, India, Malaya, Polynesia, Australia.
The Aldabra form is that with simple racemes terminating short leafy branchlets.

Deeringia indica, *Zoll.* Syst. Verzeichn. 110; non Retz. nec Spreng. Ile Picard, Dupont 26.
Distr. Malay Peninsula, Philippine Islands, Celebes, New Guinea. This differs from *D. celosioides*, R.Br., in having solitary axillary spikes much shorter than the leaves, but with rather larger flowers.

Achyranthes aspera, *L.*; Baker, Flora, p. 268; *Kew Bull.*, 1894, p. 150; Schinz in Abhandl. Senckenb. xxi. p. 83.
Abbott; *Fox* 233; *Thomasset* 230; *Voeltzkow.*
Also St. Pierre, Dupont 22.
Distr. Tropics of both hemispheres.

Apterantha oligomeroides, *C. H. Wright* in *Kew Bull.*, 1918, p. 203.
Dupont 56, *Thomasset* 237.
Distr. Endemic.

Celosia madagascariensis, *Poir.*, Encycl. v. p. 39. *Celosia phytolaccæfolia*, Juss., DC. Prodr. xiii. 2. p. 253.
Fox 240, 248.
Distr. Madagascar.

Amarantus tristis, *L.*
Thomasset 237.
Distr. Tropical regions.

Chenopodiaceae.

Salicornia pachystachya, *Bunge?* Ungern-Sternberg, Versuch einer Systematik der Salicornieen, pp. 42, 51.
Fryer 49.
Distr. Madagascar.
Salicornia pachystachya, Bunge, is described as allied to *S. herbacea*, L., and the Aldabra plant might well be the latter; introduced perhaps in ballast. I have seen no other specimen of the genus from the Madagascar or Mascarene regions.

Loranthaceae.

Loranthus aldabrensis, *Turrill* in *Kew Bull.*, 1918, p. 203.
Thomasset 29, *Fryer* 8, *Dupont* 10.
Distr. Endemic.
Fox 241 (with immature fruits and leaves) and *Dupont* 107 (leaves and branches only) probably belong to this species.

Viscum triflorum, *DC.*; Baker, Flora, p. 134.
Fryer 48; *Thomasset* 216; *Dupont* 33.
Distr. Madagascar, Mauritius, Reunion.
[*Hernandia peltata* and *Cassytha filiformis* are not represented in the Aldabra collections at Kew, but they are likely to occur in the island as both are common in Seychelles and in several of the smaller islands near Aldabra as well as in the Mascarenes.

Euphorbiaceae.

Euphorbia Abbottii, *Baker* in *Kew Bull.*, 1894, p. 150; Schinz in Abhandl. Senckenb. xxi. p. 86.
Abbott; *Dupont*; *Voeltzkow*; *Fryer* 52.
Distr. Dupont records this from all the islands of the Seychelles region except Gloriosa, but not from the Seychelles Archipelago.

Euphorbia hirta, *Linn.*; N.E.Br. in Dyer Fl. Trop. Afr. vol. vi. sect. i. 496. *E. pilulifera,* Jacq.; Baker, Flora, p. 303.
Fryer 100.
Distr. A common weed in the tropics.

Euphorbia hypericifolia, *L.*; Baker, Flora, p. 303; N.E.Br. in Dyer Fl. Trop. Afr. vol. vi. i. p. 498.
Fox 292.
Distr. Tropical and subtropical countries of both hemispheres.

Euphorbia prostrata, *Ait.*; Baker, Flora, p. 302.
Fox 224; *Dupont* 53, 203; *Thomasset* 232.
Distr. Tropical Africa and America.

Wielandia elegans, *Baill.*; Hemsl. in Hook. Ic. Pl. t. 2813.
Fryer 84.
Distr. Also in Seychelles.

Phyllanthus casticum, *Willem.*; Baker, Flora, p. 311.
Dupont 7.
Distr. Madagascar, Mauritius.

Phyllanthus Cheloniphorbe, *Hutchinson* in *Kew Bull.*, 1918, p. 204.
Abbott; *Thomasset* 227; *Dupont* 66, 112, 116; *Fryer* 17, 35, 87.
A small soft-wooded tree the leaves of which are eaten by tortoises (Dupont).
Distr. Endemic.

Phyllanthus maderaspatensis, *L.*; Baker, Flora, p. 309.
Thomasset.
Distr. Tropics of the Old World.

Acalypha claoxyloides, *Hutchinson* in *Kew Bull.*, 1918, p. 205.
Abbott; *Fryer* 18; *Thomasset* 243
Distr. Aldabra, Astove, Cosmoledo.

This is the "*Claoxylon* near *C. indicum*, Hassk." referred to in *Kew Bull.* 1894, p. 150. According to Thomasset it is one of the commonest shrubs in Astove, Cosmoledo and Aldabra. Both it and the following species are closely related to the Tropical East African *A. fruticosa*, Forsk.

Acalypha Fryeri, *Hutchinson* in *Kew Bull.*, 1918, p. 206.
Fryer 92.
Distr. Endemic.

Moraceae.

Ficus (Urostigma) aldabrensis, *Baker* in *Kew Bull.*, 1894, p. 151; Dupont, Report, 1907, p. 40.
Abbott; *Dupont* 39; *Fryer* 31; *Thomasset* 220, 253.
Distr. Dupont reports this species from Astove, Cosmoledo, Assumption and Gloriosa.

Ficus consimilis, *Baker*, Flora, p. 286; Balfour, Bot. Rodriguez, reprint, p. 67.
Fryer 13, 30, 33; *Thomasset* 219. *Dupont* 38.
Distr. Seychelles and Rodriguez.

Ficus nautarum, *Baker*, Flora, p. 285; *Kew Bull.*, 1894, p. 151; Schinz. Abhandl. Senckenb. xxi. p. 83; Dupont, Report, 1907, p. .
Abbott; *Fryer* 14.
Distr. Mauritius, Seychelles. Dupont records this species from all of the islands in his tabular view.

Urticaceae.

Obetia morifolia, *Baker* in Journ. Linn Soc., Bot., xx. 263 (1883).
Dupont 127; *Fryer* 17.
Distr. Also in Madagascar.

Casuarinaceae.

Casuarina equisetifolia, *Forst.*; Baker, Flora, p. 294; Schinz in Abhandl. Senckenb. xxi. p. 81; Dupont, Report, 1907, p. 40.
Recorded by *Abbott*, *Gardiner* and *Voeltzkow*, though not collected by them.
Distr. Dupont records this from all the islands in his table, and also from Madagascar and the Mascarenes. It is supposed to be a native of the Malay Archipelago, but it seems to have spread widely independently of human agency.

Orchidaceae.

Although a number of Orchids inhabit Seychelles and members of the family are numerous in the Mascarenes, no species is recorded from any of the islands dealt with in this paper except Aldabra and Agalega. Absence or great rarity of Orchids is the rule in the vegetation of coral islands and other remote islands.

Acampe sp. aff. **A. Renschiana,** *Reichb. f.* Otia Bot. Hamb. p. 77.

Fox 287; *Fryer.*

Distr. Madagascar is the native country of the species named.

Angraecum eburneum, *Thouars*; Baker, Flora, p. 356.

Fox 288.

Distr. Seychelles; Bourbon.

In addition to the foregoing there were in Dupont's collection a flowerless branch of an orchid, probably an *Angraecum*, and a detached seed-pod.

Commelinaceae.

Commelina benghalensis, *L.*; Baker, Flora, p. 324.

Fryer.

Distr. Tropical Africa and Asia.

Dioscoreaceae.

Bioscorea nesiotis, *Hemsl.* in Journ. Bot., 1917, p. 288.

Thomasset 218, 241.

Distr. Also collected by Dupont in Assumption n. 118. A specimen of a different species probably was collected by Fox, n. 274.

Liliaceae.

Asparagus umbellulatus, *Sieber*; Baker, Flora, p. 377; *Kew Bull.*, 1894, p. 151; Dupont, Report, 1907, p. 41.

Abbott; *Dupont*; *Fryer* 4.

Distr. Mascarenes.

Dupont records this plant from Astove, Cosmoledo and Assumption. Concerning this plant Mr. C. H. Wright remarks: "This does not agree with typical *A. umbellulatus*, but is connected with it by Johnston's no. 16. I regard *A. umbellulatus* as a variable species, for one branch on Fryer's no. 4 bears cladodia like those on the type."

Lomatophyllum borbonicum, *Willd.*; Baker, Flora, p. 374; *Kew Bull.*, 1894, p. 151; Schinz in Abhandl. Senckenb. xxi. p. 82; Abbott in *Kew Bull.*, 1893, p. 155; Dupont, Report, 1907, p. 41.

Abbott; *Dupont*; *Fryer* 3; and all other collectors.

Distr. Madagascar, Mascarenes.

And, on the authority of Dupont, also Astove, Cosmoledo and Assumption.

This is doubtless the "Aloe-like plant" of Abbott, who states that it was the most conspicuous in Aldabra.

Dracaena reflexa, *Lam.*; Baker, Flora, p. 375; *Kew Bull.*, 1894, p. 151; Dupont, Report, 1907, p. 41.

Abbott; *Dupont.*

Distr. Tropical Africa; Madagascar; Mascarenes.

Dupont records *Dracaena reflexa* from Astove, Cosmoledo, Assumption and Seychelles.

Pandanaceae.

Pandanus Vandermeeschii, *Balf.* in Baker, Flora, p. 398; Schinz in Abhandl. Senckenb. xxi. p. 81; Dupont, Report, 1907. p. 41. *Foullioya maritima*, Gaud., Voy. de la Bonite, t. 26, f. 21-24.

Dupont; *Fryer.*

Distr. Mascarenes.

There is some doubt about this being the same species as that from the outlying islets of Mauritius.

Naiadaceae.

Cymodocea ciliata, *Ehrenb.* ex Aschers. in Sitzber. Gesellsch. Naturf. Freunde, Berl. 1867, p. 3.

Fox 218; *Fryer.*

Distr. Red Sea, Indian and Pacific Oceans.

Cymodocea is not recorded in Baker's Flora; but Professor Stanley Gardiner has some most interesting notes on the genus, inaccessible to me now.

Cymodocea rotundata, *Aschers.*; Fl. Trop. Afr. viii. p. 230.

Fox 206, 217.

Distr. Red Sea; Indian Ocean.

Cyperaceae.

(By W. B. Turrill.)

Cyperus compressus, *L.*; Baker, Flora, p. 410; Cordemoy, Fl. Réunion, p. 129.

Abbott.

Distr. Tropical and subtropical regions of both hemispheres.

Cyperus articulatus, *L.*; Fl. Trop. Afr. viii. p. 356.

Fox 295.

Distr. Tropical and sub-tropical regions of both hemispheres.

Cyperus sp., near **C. debilissimus,** *Baker* in Journ. Linn. Soc., Bot., xxii. 1887, p. 532.

Fox 231.

Distr. Madagascar.

Cyperus compactus, *Lam.*; Baker, in *Kew Bull.*, 1894, p. 151; Schinz in Abhandl. Senckenb. xxi. p. 82; Dupont, Report, 1907. p. 41.

Abbott; *Dupont* 85; *Fox* 277; *Thomasset* 231, 252.

Distr. Tropical and South Africa and the Mascarene Islands.

Mariscus rufus, *H.B.K.* Nov. Gen. et Sp. i. p. 216. t. 67.

Dupont 52; *Fryer* 25; *Thomasset.*

Distr. Mascarenes; Africa; Madeira; Tropical America.

Mariscus Dregeanus, *Kunth*; Fl. Trop. Afr. viii. p. 380.

Fryer 26, 27.

Distr. Tropical and South Africa, Mascarene Islands, India and Malaya.

Fimbristylis obtusifolia, *Kunth;* Baker in *Kew Bull.*, 1894, p. 151; Dupont, Report, 1907, p. 41.
Abbott; *Fox* 276; *Fryer* 24; *Thomasset* 250.
Distr. Tropical and South Africa, Mascarenes and tropical America.

Fimbristylis spathacea, *Vahl,* formae; *Fimbristylis glomerata,* Nees, formae; Baker, Flora, p. 419.
Dupont 17; *Thomasset* 263.
Distr. Common in all the Mascarene Islands.
Small plants, less rigid, with finer leaves and laxer inflorescences of fewer spikes than in the type.

Fimbristylis ferruginea, *Vahl*; Baker, Flora, p. 419; Cordemoy, Fl. Réunoin, p. 131.
Dupont 17; *Fryer* 12, 28.
Distr. In tropical and warm temperate countries nearly throughout the world.

Gramineae.

(By O. Stapf.)

Ischaemum rugosum, *Sal.*
Fox 230.
Distr. Throughout the Indo-Malayan region.

Digitasia horizontalis, *Willd.; Panicum sanguinale* var. *ciliare* (partly), Baker, Flora, p. 435.
Fryer.
Distr. Throughout Tropical Africa, the Mascarenes and Tropical America.

Panicum maximum, *Jacq.*; Baker, Flora, p. 436; Schinz in Abhandl. Senckenb. xxi. p. 82.
Fox 208; *Voeltzkow* 33, 38.
Distr. A native of Tropical Africa and Sub-tropical South Africa, introduced into most warm countries and often grown for fodder.

Panicum Meyerianum, *Nees.*
Dupont 75, 99; *Fryer*; *Fox* 293.
Distr. Eastern Tropical Africa, Natal, Madagascar, Tropical Arabia.

Stenotaphrum subulatum, *Trinius*; Baker, Flora, p. 440.
Dupont 55.
Distr. Galega, Mascarenes, Polynesia, including New Caledonia.

Pennisetum setosum, *Rich.*; Baker, Flora, p. 441, in nota. *Pennisetum polystachyum,* Schutes; Schinz in Abhandl. Senckenb. xxi. p. 82; Dupont, Report, 1907, p. 41.
Dupont; *Voeltzkow.*
Distr. Widely distributed through the tropics of both hemispheres.

Sporobolus virginicus, *Kunth*; Baker, Flora, p. 449, under *Vilfa*.
Dupont 67, 74; *Gardiner*.
Distr. A very variable littoral plant of most warm countries.

Eragrostis riparia, *Nees*.
Dupont 40, 64, 109, 202; *Thomasset* 223, 229; *Fryer* 4; *Fox* 237, 252.
Distr. India; Mascarenes; probably also East Africa.
Dupont 64 and *Fryer* 4 are noteworthy on account of the remarkably stiff and stunted habit.

Sclerodactylon juncifolium, *Stapf*. in *Kew Bull.*, 1911, p. 318.
Dupont 72, 105; *Fryer*.
Also Piquart or West Island, from sea shore along coast near settlement, Baty.
Distr. Madagascar.

Enteropogon melicoides, *Nees*.
Dupont 268; *Fryer*; *Thomasset* 249.
Distr. India; East Africa; Mascarenes; Assumption, *Fox* 238, 257.

Chloris radiata, *Swartz*.
Dupont 34; *Thomasset* 222.
Distr. Tropical America and Africa; Polynesia; introduced in other hot countries.

Dactyloctenium aegyptiacum, *Willd.*; Baker, Flora, p. 452; Schinz in Abhandl. Senckenb., xxi. p. 81.
Fryer; *Voeltzkow*.
Distr. Widely spread throughout the tropical and subtropical regions.

Dactyloctenium pilosum, *Stapf*, species nova, affine *D. aegyptiaco*, Willd., sed gracilius, spicarum lana et spicularum armatura distinctum.
Perenne (?). Culmi e basi saepe longe prostrata e nodis ramosa et radicante ad 1·2 dm. ascendentes, secundarii (rami) suberecti vel geniculato-ascendentes saepe fasciculati, 4-5 (rarius pluri-) nodi, internodiis magis minusve compressis vel superioribus teretibus glabris, demum plerumque magis minusve exsertis. *Foliorum* vaginae striatae, superne saepe subcarinatae, laxiusculae vel summae primo subinflatae, glabrae, nisi os versus pilosae vel barbatae; ligulae ad marginem membranaceum redactae; laminae lineares, tenuiter acutae, 2·5 cm. longae, 1-2 mm. latae, glaucescentes, praeter barbas orales glabrae vel parce pilosae pilis saepe e tuberculis ortis, ad margines superne scabrae, nervis obscuris vel infra prominulis paucis. *Spicae* 2-nae, rarius solitariae, rarissime 3-nae, 1·5-3·5 cm. longae, rectae vel demum falcato-recurvae, pallide glauco-virentes, deinde stramineae, densissimae; rhachis circiter 1 mm. lata, in dorso subacute vel obtuse carinata, ad spicularum insertiones lana parca spiculis paulo vel subduplo breviore stipata, caeterum glabra, apice in

spinam brevem producta. *Spiculae* anthoeciis 3-5 quorum infimum vel 2 infima ♀, caetera redacta ♂ vel neutra, ambitu late ovatae vel subrotundae, $1\frac{3}{4}$-2 mm. longae, a latere admodum compressae, densissime imbricatae, tardissime delabentes; rhachilla tenax, glabra. *Glumae* circiter 3 mm. longae, inferior a latere visa oblique oblonga vel sublanceolata, acuminata vel subacuta, 1-nervis carinata, carina scabra, superior (ad rhachis marginem spectans) a latere visa oblique oblonga vel elliptico-oblonga, apice emarginata, nervo carinali sublaeve in mucronem brevem spinescentem eius curvaturam continuentem abeunte. *Anthoecia* perfecta ♀ spiculam aequantia, subacuminata, breviter vel brevissime mucronata, nervo carinali scaberulo, lateralibus tenuissimis; valvula valva (mucrone dempto) paulo brevior, carinis ciliolatis scabrisque. *Antherae* 1·4 mm. longae. *Caryopsis* lateraliter compressa, elliptico-quadrata, 0·8 mm. longa, 0·65 mm. lata, minute granulata, ferruginea. *Anthoecia* imperfecta quam perfecta minora, vix vel haud mucronata, caeterum iis similia, nisi angustiora.

Seychelles. Praslin, *Dupont* 30.

Mascarenes. Aldabra *Dupont* 70. *Thomasset* 228. Assumption, *Fox* 254.

The spikes of *Dupont* 70 (mature) and most of *Thomasset* 228 (young) are very markedly falcate, those of *Dupont* 30 (mature) and *Fox* 254 (young) straight or almost so.

Lepturus repens, *R. Br.*

Dupont 89; *Thomasset* 234, 248.

Distr. Coasts of the Indian Ocean and the Pacific.

A slender narrow-leaved state as occurs occasionally throughout the area of the species.

Filices.

Acrostichum aureum, *L.*; Baker, Flora, p. 514; Christensen in Trans. Linn. Soc., series 2, Bot., vii. pp. 411, 423; Dupont, Report, 1907, p. 41; Stanley Gardiner in Trans. Linn. Soc., Zool., xiv. (1910) p. 4.

Dupont 36.

Distr. Almost cosmopolitan in salt marshes in tropical and sub-tropical regions. But it is not recorded from any of the other atolls within our area, and it is the only fern known to inhabit Aldabra. It is sometimes called the Mangrove Fern.

Regional and Endemic Plants of Aldabra.

The following is a list of species comprising the indigenous element, or the bulk of the indigenous element, in the Flora of Aldabra, inclusive, of course, of the endemic species, but exclusive of widely dispersed plants. Regional is employed in a geographical sense and covers East Africa, Madagascar, Seychelles and the Mascarenes, as well as the small islands of the Western Indian Ocean. Endemic species are marked with an asterisk.

Cleome strigosa, E. Afr., Astove, Gloriosa.

**Maerua Dupontii.*
Capparis galeata, Trop. Afr., Astove.
**Grewia aldabrensis.*
**Grewia salicifolia.*
**Erythroxylon acranthum.*
**Ochna Fryeri.*
Apodytes mauritiana, Cosmoledo, Astove, Gloriosa.
Gouania Retinaria, Masc.
Gouania tiliaefolia, Masc.
Allophylus africanus, E. Afr.
Macphersonia madagascariensis, Mad., Assumption, Cosmoledo, Astove.
**Tephrosia aldabrensis.*
**Cassia aldabrensis.*
**Pithecolobium ambiguum.*
Gagnebina tamariscina, Mad., Cosmoledo.
Desmanthus Commersonianus, Mad.
Weihea Tomassetii, Nossi Bé.
Terminalia Fatraea, Mad.
**Oldenlandia species nova?*
Tarenna nigrescens, E. Afr., Seych.
**Tricalysia cuneifolia.*
Polysphaeria multiflora, E. Afr. Assumption.
Plectronia bibracteata, Seych., Mauritius.
Pavetta trichantha, Assumption.
**Pavetta supra-axillaris.*
Psychotria Pervillei, Seych.
Triainolepis Hildebrandtii, Mad., E. Afr.
Rutidea coriacea, Masc.
**Vernonia aldabrensis.*
**Plumbago parvifolia.*
Plumbago aphylla, Assumption, Cosmoledo, Astove, Gloriosa.
Sideroxylon inerme, E. Afr.
**Jasminum aldabrense.*
Salvadora angustifolia, Mad.
Microstephanus cernuus, E. Afr., Mad., Assumption, Astove.
Sarcostemma viminale, E. Afr., Mad., Assumption, Cosmoledo, Astove.
Secamonè Fryeri, Assumption.
Solanum aldabrense, Assumption, Cosmoledo, Astove, St. Pierre.
Hypoestes aldabrensis, Assumption, Astove.
Hypoestes serpens, Mad.
Nesogenes Dupontii, Assumption.
Clerodendron minutiflorum, Assumption, Cosmoledo.
Pisonia costata, Mauritius.
Celosia madagascarensis, Mad.
**Apterantha oligomeroides.*
Salicornia pachystachya, Mad.
**Loranthus aldabrensis.*
Viscum triflorum, E. Afr., Mad., Seych.
Euphorbia Abbottii, Assumption, Cosmoledo, St. Pierre.

Wielandia elegans, *Seych.*
Phyllanthus casticum, Mad., Masc.
**Phyllanthus Cheloniphorbe.*
Acalypha claoxyloides, Cosmoledo, Astove.
**Acalypha Fryeri.*
Ficus aldabrensis, Assumption, Cosmoledo, Astove, Gloriosa.
Ficus consimilis, Seych.
Ficus nautarum, Seych., Assumption, Cosmoledo, Astove, St. Pierre, Gloriosa.
Obetia morifolia, Mad.
Acampe Renschiana ? Mad.
Angraecum eburneum, Seych., Bourbon.
Dioscorea nesiotis, Assumption.
Asparagus umbellulatus, Assumption, Cosmoledo, Astove.
Lomatophyllum borbonicum, Mad., Assumption, Cosmoledo, Astove.
Dracaena reflexa, E. Afr., Mad., Assumption, Cosmoledo, Astove.
Pandanus Vandermeeschii, Masc. (?).
Sclerodactylon juncifolium, Mad.
Dactyloctenium pilosum, Assumption, Seychelles.

The list contains 68 species, of which 18 are endemic, 13 are limited to Aldabra and the small neighbouring islands of Assumption, Cosmoledo, Astove, St. Pierre and Gloriosa, whilst 18 extend to Madagascar, and 11 reach East Africa. Prominent among the genera found in Aldabra, but apparently absent from the small islands nearest to it are: *Grewia*, *Erythroxylon*, *Gouania*, *Tephrosia*, *Pithecolobium*, *Cassia*, *Lumnitzera*, *Sonneratia*, *Tarenna*, *Tricalysia*, *Plectronia*, *Guettarda*, *Psychotria*, *Triainolepis*, *Rutidea*, *Vernonia*, *Salicornia*, *Viscum*, *Loranthus* and *Angraecum*. Seven of these belong to the Rubiaceae, an order scarcely represented in the smaller islands. Of course it must always be remembered that Aldabra has been much more thoroughly explored than the rest of the islands.

Introduced Plants.

In addition to the plants included in the enumeration as probably indigenous, that is having reached Aldabra independently of active human agency, there is a number of undoubtedly introduced plants now existing in a more or less wild condition. Such are: *Amaranthus tristis*, *A. gangeticus*, *Brassica nigra*, *Carica Papaya*, *Gossypium barbadense*, *Ocimum canum*, *Ricinus communis* and *Lochnera rosea*. Doubtless some of those included in the enumeration might with equal justice be referred to the category of introduced plants.

The Coco-Nut.—I have not included *Cocos nucifera* in the enumeration of plants which have presumably reached Aldabra independently of the action of man, because I am now convinced that it is a native of South America, the home of all the numerous species of the genus *Cocos*, and that its present distribution is due almost entirely to human agency. Reliable

observers state that nuts cast ashore by the waves do not germinate unless buried in the soil. There is also good evidence that the Polynesians and other races carried nuts with them wherever they went on their sea-voyages and planted some in the most remote islands, as a provision against emergencies. Mr. O. F. Cook, in a masterly essay on the subject, fully proves, in my estimation, that *Cocos nucifera* is a native of inland stations in South America, so that it is not, as is commonly supposed, essentially a littoral palm, though it thrives in such situations.

Flora and Vegetation of some other small Islands of the Western Indian Ocean.

Within what may be termed the Seychelles area, and mainly to the south-west of that group, there is a number of islands—atolls, similar in size and physical characters to Aldabra. Several of these islands were visited by Dupont, Fryer, Gardiner and Thomasset, and some of them by earlier travellers, all of whom have contributed more or less to our knowledge of their

flora. But none of these islands has been so thoroughly explored, botanically, as Aldabra. Nevertheless, it seems desirable to reproduce here such data and records as are helpful in

comparisons. For this purpose also some particulars are extracted from Prain, Stanley Gardiner, Willis and the present writer's accounts of the botany of the more easterly Laccadives, Maldives and the Chagos Archipelago.

Assumption.

Dupont remarks of Assumption that its flora resembles more closely that of Aldabra than some of the other neighbouring islands. Out of 97 Aldabra species he records in his distribution table 40 as occurring in Assumption. Among these are *Polanisia strigosa, Capparis galeata, Thespesia populnea, Hibiscus tiliaceus, Scutia Commersonii, Schmidelia africana, Macphersonia madagascariensis, Guettarda speciosa, Plumbago aphylla, Solanum aldabrense, Sarcostemma viminale, Cassytha filiformis, Ficus nautarum, F. aldabrensis, Euphorbia Abbottii, Casuarina equisetifolia, Lomatophyllum borbonicum, Dracaena reflexa, Asparagus umbellatus, Dioscorea nesiotis* and *Fimbristylis exilis.*

A later numbered collection by Mr. Dupont includes the following additional species: *Cissampelos Pareira* (in a broad sense), *Sida diffusa, Suriana maritima, Cannavalia obtusifolia, Launaea bellidifolia, Oldenlandia corymbosa, Pavetta trichantha, Polysphaeria multiflora, Secamone Fryeri, Justicia procumbens, Hypoestes aldabrensis, Nesogenes Dupontii, Clerodendron minutiflorum, Celosia phytolaccifolia,* and *Panicum assumptionis,* Stapf (sp. nov.).

Fryer contributes *Pemphis, Plumbago, Microstephanus, Euphorbia Abbottii, Ficus* and *Dracaena.* And Fox adds: *Eriochloa subulifera,* Stapf. (sp. nov.), 256, 261; *Stenotaphrum clavigerum,* Stapf (sp. nov.), 255; *Eragrostis riparia,* Nees, 237, 252; and *Dactyloctenium pilosum,* Stapf (see p. 135), 254. Descriptions of the 3 new species by Dr. Stapf are appended here.

Panicum assumptionis, Stapf; species nova; affine *P. pinifolio,* Chiov. (syn. *P. Appletonii,* Stapf), sed caulibus multo gracilioribus, foliorum laminis multo tenuioribus molliter hirsutis acutis planis haud aciniformibus, spiculis minoribus distinctum.

Perenne; rhizoma breve, mox dissolutum, aut fasciculos culmorum erectorum vel longe ascendentium et radicum fibrillos tenues e basi emittentium aut soboles prostratos edens, innovationibus foliatis additis. *Caules* sobolesque tenues, longiores ad 2 dm. longi internodiis 1·2-2 rarius ultra 2·5 cm. longis, e nodis omnibus fasciculatim ramosi vel inferne simplices, ramis longioribus interdum eodem more ramulosis, ramorum ramulorumque fasciculis circiter 2 cm. longis densis. *Foliorum* vaginae firmae, breves, glabrae vel interiores fasciculorum parce pilosae, basales 5 mm. longae, culmorum primariorum duplo longiores, sensim in laminas abeuntes et cum iis longe persistentes, fasciculos ramulorum suffulcientes, eae fasciculorum multo breviores; ligulae ad lineam pilorum redactae; laminae lineari-lanceolatae vel sublineares, acutae vel tenuiter

acuminatae inferiores et culmorum primariorum 3·5-2 cm. longi, ad 3 mm. lati, secundariorum et ordinum superiorum 1 cm. longi vel breviores angustioresque, dorso laxe molliter hirsutae, omnes e vernatione convoluta mox explanatae. *Paniculae* numerosae in ramulis fasciculorum, eos vix superantes, 1 cm. longae; axis primaria et rami patuli vel recurvi, vix 5 mm. longiores, tenuiter filiformes, pilosi; pedicelli laterales ad 1·5 mm. longi, apice paululo dilatati. *Spiculae* ovoideo- vel obovoideo-ellipsoideae, subacutae, 1·25 mm. longae, glabrae, viridulae, deinde pallescentes. *Glumae* membranaceae, inferior late ovata, acuta vel subacuta, basi amplectens, 1-nervis, superior spiculam aequans et eodem ambitu, 5-nervis, nervis superne prominulis. *Anthoecium* inferum neutrum: valva glumae superiori simillima; valvula nulla. *Anthoecium* superum ♂, infero vix brevius, maturum fuscescens: valva elliptica, obtusa, papyracea, 5-nervis; valvula substantia simillima, vix brevior, utraque laevis, nitens. *Antherae* 0·75 mm. longae.

Mascarenes. Assumption Island, on rocky ground, *Dupont*, 110.

Eriochloa subulifera, *Stapf*, species nova; affinis *E. acrotrichae*, Hack. ex Thellung, sed racemis laxis, pedicellis elongatis, spiculis dissitis minoribus pro ratione longius aristulatis distincta.

Annua, ultra 5 dm. alta, gracilis. *Culmi* solitarii vel parce fasciculati, tenues, geniculatim ascendentes, 3-4-nodi, e nodis inferioribus ramosi, glabri, nisi sub paniculam parce pilosi. *Foliorum* vaginae sublaxae, tenuiter striatae, glabrae, interdum pubescentes, intermediae et superiores quam internodia breviores; ligulae ad lineam ciliolatam reductae; laminae lineares, apicem versus longe attenuatae, acutae, basin versus aequilatae vel paulo angustatae, 4-8 cm. longae, $1\frac{1}{2}$-$2\frac{1}{2}$ lin. latae, tenues, glabrae, fere omnino laeves, nervo medio tenui. *Panicula* ambitu late oblonga, 4-9 cm. longa, 2·5-4 cm. lata, racemis 4-9 distantibus demum oblique erectis vel patulis, axi communi uti axibus ordinum superiorum undique pilosula pergracili. *Racemi* breviter pedunculati vel superiores subsessiles, 3·5-1·8 cm. longi, laxi, gracillimi; rhachis filiformis, angulata, 0·2-0·5 mm. lata, internodiis 2·5 mm. longis; pedicelli solitarii vel inferiores 2-nati, secundariis brevissimis, primariis ad 2·5 mm. longis, omnibus apice subdiscoideis. *Spiculae* dissitae, ovato-lanceolatae vel oblongae, subulato-aristulatae, annulo incluso sed aristula dempta 2·5 mm. longae, pallide virides, sericeae; internodium globosum basale 0·25 mm. diametro. *Gluma* inferior ad marginem membranaceum redacta, superior ambitu longitudine spiculae, tenuiter 5-nervis, aristula ultra 1 mm. longa. *Anthoecium* inferum ad valvam glumae superiori similem acutam emucronatam fere 3 mm. longam redactum. *Anthoecium* superum ♂; valva oblongo-elliptica, obtusa, 2 mm. longa, mucronulo fere 0·5 mm. longo barbellato. *Antherae* 1 mm. longae.

Mascarenes. Assumption Island, *Fox* 258, 261.

Stenotaphrum clavigerum, *Stapf,* species nova; affines *S. oostachyo,* Baker, sed annuum, multo gracilius et foliis angustis sursum longe attenuatis acutis, spicis gracilioribus ambitu plerumque ovato-lanceolatis distinctum.

Annuum, fasciculato-caespitosum, 2 dm. altum. *Culmi* pergraciles, glabri, erecti vel breviter geniculatim ascendentes, 8-nodi, e nodis inferioribus intermediisque crebre ramosis; rami inferiores culmos secundarios referentes. *Foliorum* vaginae laxae vel subtumidae, magis minusve compressae et superne carinatae, praeter nodos adpresse barbatos glabrae, tenuiter striatae, pallidae; ligulae ad marginem ciliatum reductae; laminae lineares, sursum longe attenuatae, acutae, 3-5 cm. longae, 2-3 mm. latae, vernatione plicatae, deinde saepe planae, tenues, subglaucae, glabrae vel interdum basi utrinque barbatae, margine scaberulae. *Spicae* solitariae pedunculo (internodio summo) circiter 3 cm. longo e vagina summa demum longe exserto sursum incrassato et ibi parce pilosulo suffultae, ambitu ovato-lanceolatae, rarius oblongae, 7-8 mm. longae, 2-2·5 mm. latae, leviter compressae, pallide virides, axi paulo ultra spiculas producta obtusa inter spiculas oblique constricta. *Spiculae* solitariae in excavationibus axis nidulantes vel sub anthesi magis minusve hiantes et divergentes, circiter 5 cum quaque spica, ad eius latera superpositae, 2 mm. logae. *Glumae* ad squamas albidis rotundatas vel (interior) lobulatas enerves 0·3-0·5 mm. longas reductae. *Anthoecium* inferum (exterior) ♂: valva a dorsa visa oblonga, acuta, superne carinata, spiculam aequans, chartacea, albida, laevis, 3-nervis; valvula valvae aequilongae, alato-2-carinata, obtusa; antherae 1·5 mm. longae. *Anthoecium* superum ♀ quam inferum paulo brevius: valva navicularis, acuta, tenuiter chartacea, 3-nervis; valvula valvam aequans, 2-nervis; antherae ut in ♂.

Mascarenes. Assumption Island, *Fox* 255.

Cosmoledo.

Baty specially mentions *Pemphis, Tournefortia, Carapa, Rhizophora* and *Casuarina* as inhabiting this atoll. Dupont also enters into some details of the mangrove vegetation, comprising the genera just mentioned with the addition of *Bruguiera, Ceriops,* and *Avicennia.* But he gives no general account of the vegetation. Fryer adds little, but he states that the type of vegetation characteristic in Aldabra is quite absent. Goëlette Island, on the east side of the atoll, he found, was "thickly studded with *Plumbago aphylla,* a herb which produces leaves at the beginning of the wet season but speedily loses them."

Dupont tabulates 43 species of plants from Cosmoledo, including *Apodytes, Plumbago, Solanum aldabrense, Sarcostemma, Ficus natutarum, F. aldabrensis, Cassytha, Euphorbia Abbottii, Casuarina, Lomatophyllum, Dracaena reflex* and *Asparagus umbellulatus.*

A later collection from Dupont adds: *Gouania tiliaefolia, Gagnebina tamariscina, Evolvulus alsinoides* and *Clerodendron minutiflorum*. A species of *Oxalis* (near *O. villosa*, Baker, a Madagascar species) was collected. This genus is not recorded from any of the other islands.

Astove.

Baty states that "the forest of Astove is composed of forest trees and flowers of Madagascar. Their growth is very stunted, but very thick, especially along a belt of 200 ft. near the lagoon. The commonest of all the trees is the Bois D'Amande" —*Pemphis acidula*.

Dupont's contribution to the Botany of Astove is limited to 39 species in his Distribution Table. These include *Hibiscus tiliaceus, Thespesia populnea, Apodytes mauritiana, Colubrina asiatica, Scutia Commersonii, Schmidelia africana, Macphersonia madagascariensis, Cordia subcordata, Solanum aldabrense, Astephanus arenarius, Avicennia marina, Pisonia macrophylla, Ficus nautarum, F. aldabrensis, Cassytha filiformis, Casuarina equisetifolia, Lomatophyllum borbonicum, Dracaena reflexa* and *Asparagus umbellulatus*. It will be realised that several of the plants named are common to Aldabra and not ordinary littoral types. It may be noted, too, that no true mangrove is recorded. Fox collected *Panicum maximum*, a widely cultivated species, in this island, no. 285.

Fryer has the following paragraph:—"The bush in places resembles Aldabra *Pemphis* scrub, and in others the open country of Assumption. It was very bare and dead during my visit, and hardly a score of plants were obtained in flower, though during the dry season it is supposed to be the most luxuriant of all the Aldabra series." He collected specimens of: *Polanisia strigosa, Capparis galeata, Plumbago aphylla, Sarcostemma viminale, Ipomoea biloba, Evolvulus alsinoides, Hypoestes aldabrensis, Asystasia coromandeliana and Boerhaavia diffusa*.

Farquhar.

The little that is known of the vegetation of these islands points to no peculiarities. Dupont has nothing on record. Concerning Farquhar, Gardiner says of South Island, "Although the islands are so close to Madagascar the plants were again the same as those of Chagos and Coëtivy. The coco-nuts of North Island had been nearly all blown down by a hurricane in 1893, but were still growing, having bent up through an angle of 90°, leaving 10 to 15 ft. of their stems lying prone on the ground. Near them were great groves of *Casuarina*." *Pemphis, Scaevola* and *Tournefortia*, etc., appear in the illustrations.

Providence.

A sample of the flora of Providence, collected by Dr. R. W. Coppinger, on the cruise of the "Alert," 1878-82, follows here:—*Sida carpinifolia, S. spinosa, Abutilon indicum, Triumfetta procumbens, Cassia occidentalis, Desmanthus virgatus,*

Suriana maritima, *Ochrosia borbonicum*, *Tournefortia argentea*, *Ipomoea glaberrima*, *Striga hirsuta*, *Boerhaavia diffusa*, *Hernandia peltata*, *Cassytha filiformis*, *Euphorbia pilulifera*, *E. prostrata*, *Fleurya aestuans*, *Cyperus ligularis*, *Fimbristylis glomerata*, *Eleusine aegyptiaca*. This small collection is in the Kew Herbarium.

As will be seen these are all common and mostly sea-side species; but *Ochrosia borbonica* (*Apocynaceae*) and *Hernandia peltata* (*Lauraceae*) are additions to our insular floras, though both are common on the coast of Seychelles and may be expected to occur in Aldabra. Dupont tabulates only about fifteen of the Aldabra plants from Providence; all of the commonest.

St. Pierre.

Dupont tabulates 23 of the Aldabra plants as common to St Pierre, among these *Hibiscus tiliaceus*, *Thespesia populnea*, *Brexia madagascariensis*, *Pemphis acidula*, *Terminalia Catappa*, *Scaevola*, *Tournefortia*, *Cordia*, *Solanum aldabrense*, *Pisonia macrophylla*, *Euphorbia Abbottii*, *Ficus nautarum* and *Casuarina*. Of these *Brexia* and *Terminalia Catappa* are not recorded from Aldabra, though the latter is likely to occur. *Brexia spinosa* is the variety recorded from St. Pierre; but the genus is apparently absent from all the other islands outside of the Seychelles group. All the forms of *Brexia* are usually referred to *B. madagascariensis*, which is common in some of the Seychelles Islands, and is found in Madagascar and East Africa. *Euphorbia Abbottii*, a shrubby species, belongs to a section, peculiar according to Baker, to the Mascarenes. Dupont records it from all the islands except Gloriosa. An apparently new species of *Hippocratea* (Hemsl. in Journ, Bot. 1916, Suppl. II. p. 9), St. Pierre, *Dupont* 4, is a "bushy climber not found elsewhere."

Although Dupont records so few species he states that "as regards its flora St. Pierre is much like that of Aldabra." On the other hand he does not tabulate any mangroves as growing in either of these three islands. The same with the Amirantes, Astove, Assumption, Comoros and Gloriosa. But this is probably due to an oversight or an accidental omission. Gardiner gives a few facts in the ensuing paragraph:—

"From the sea St. Pierre presents an appearance remarkably like one of the Tongan or Fijian raised coral islets. It is surrounded by perpendicular or overhanging cliffs varying up to about 30 ft. in height. At most parts the cliffs are crowned with old gnarled bushes of *Pemphis*. Inside is a dense mass of small trees—*Hibiscus*, with masses of red flowers, *Pisonia* with stunted stems never able to reach above the general level of 20 ft. or so, and the tanghin, the famous poison-tree of Malagasy natives.* The last presented an extraordinary spectacle as a

* Professor Gardiner informs me that this statement requires correction. The "tree with bare stems" is *Euphorbia Abbottii*. The Tanghin of the Malagasy is *Cerbera venenifera*, Steud. (*Tanghinia venenifera*, Poir.; *T. veneniflua* (err.), Hook. Miscell. iii. p. 289, t. 110). It attains considerable height and has the habit of a mango tree.—O. S.

forest of bare stems, being completely leafless, while most tropical trees gradually lose and replace their leaves. Other plants were of the reguar species which can stand the guano."

Gloriosa.

The following is a list of plants in the Kew Herbarium collected by Dr. Coppinger in Du Lise Island, Gloriosa. It has already appeared in my Introduction to the Botany of the Challenger Expedition:

Cleome strigosa, Portulaca quadrifida, Sida spinosa, Hibiscus Hornei, Thespia populnea, Pemphis acidula, Cucumis trigonus, Cordia subcordata, Ipomoea glaberrima, Solanum nodiflorum, Boerhaavia diffusa, Euphorbia prostrata, Cyperus rotundus, Eragrostis tenella. This is the only record of *Hibiscus Hornei* outside of Seychelles; but I have not been able to verify the determination.

In a sketch of the natural history of Aldabra Mr. Abbott remarks that Gloriosa seemed comparatively rich in plants. *Casuarina* and Mangroves are recorded by him; the latter "50-60 ft. high."

Dupont tabulates only 20 of the Aldabra plants as occurring in Gloriosa, and these are mostly widely dispersed species. Among them, however, are *Ficus nautarum, F. aldabrense, Apodytes mauritiana, Cassytha filiformis* and *Casuarina*. No Mangrove, no member of the *Rubiaceae* except *Guettarda speciosa*, and no monocotyledonous plant. *Cassytha* has apparently not been collected in Aldabra.

Amirante Group.

Kew possesses two small collections from this group, made by Dr. Coppinger. In Des Roches he collected: *Calophyllum Inophyllum, Sida spinosa, Abutilon indicum, Triumfetta procumbens, Suriana maritima, Morinda citrifolia* and *Vernonia cinerea*. And in Poivre: *Pemphis acidula, Guettarda speciosa, Tournefortia argentea, Casuarina equisetifolia. Vernonia cinerea* is an addition, but it is a common weed in the tropics of the Old World.

Dupont records only 20 species of plants from this group, mostly of the commonest, and including no mangroves, *Sarcostemma viminale, Ficus nautarum* and *Euphorbia Abbottii* being the only regional representatives.

Gardiner reports as follows of Poivre Island:—"As rich in coco-nuts as any we saw. The whole was overshadowed by a high clump of bois blanc, *Hernandia peltata*, while Casuarinas grew everywhere on the shore. Under the coco-nuts was a pleasing undergrowth of papayas, cassias, castor-oil and ferns; the first occurrence of the latter in any abundance since leaving the Chagos." Gardiner also mentions *Barringtonia speciosa*, hitherto not reported from Aldabra or any of our other small islands.

With the exception of *Acrostichum aureum* in Aldabra, this is the only record of ferns in the islands coming within our area west of theChagos Archipeago. Kew possesses no specimens of ferns from the Amirantes.

Coëtivy.

This island lies a little to the south of Seychelles, and was visited by the Sealark Expedition. We are indebted to Professor Gardiner for the following notes from the second part of his Description of the Voyage. Coëtivy is described as about six miles long by one-and-a-half across its broadest part.

"The character of the vegetation was the same as that which we found in the Chagos Archipelago on similar dry, sandy and tuff islands. It consists of low bush, formed mainly of *Scaevola* and *Erythroxylon*, the former with thick succulent stems and leaves like the laurel, and the latter with tiny leaves, yellow flowers, and stems covered with mossy lichens. The ground between was mainly covered with isolated plants of a low rush (sedge ?), while struggling clumps of the hairy-leaved *Tournefortia* and of the thinner-leaved *Pisonia* we found here and there. Probably there were not 20 species of plants altogether on this kind of land, but the lower patches yielded a more considerable variety of species. These, when compared, proved to be almost precisely the same as those obtained from the Chagos. This was to us a source of considerable astonishment, because, from the island being so much nearer to Africa, to Madagascar, to the Seychelles, and to many other islands which might serve as stopping-places from the more distant lands, we had certainly expected to find a considerably greater variety of plants. Actually, we catalogued 92 species as against 85 in the Ile du Coin Peros, Chagos; the increase being mainly due to rather more plants of cultivation. The only new group of trees were the vacoa (*Pandanus*), of which, though formerly very widely spread, there were left only two clumps. The badamier, *Terminalia Catappa*, was certainly indigenous, whereas it has possibly been introduced into Chagos. Finally the gayac (*Afzelia*) was the only absentee that our lists show among the indigenous trees of the Chagos."

I have not seen the plants collected by Dr. Simpson in Coëtivy. The cases of *Afzelia* and *Pandanus* are interesting, for we may assume that these trees have disappeared from some of the islands under consideration here.

Agalega.

There is a report by G. Lincoln on the coco-nut industry of Agalega, but it contains no botany.

Nesogenes prostrata is only known from the Agalega Islands. There are several specimens in the Kew Herbarium, probably all collected by Bouton.

Baker records the following plants from Agalega, all or nearly all collected by Bojer:—*Afzelia bijuga*, *Radamaea prostrata* (*Nesogenes prostrata*, Hemsl.), *Pisonia macrophylla*, *Pipturus argenteus*, *Disperis tripetaloides* (*Orchidaceae*), and *Stenotaphrum subulatum*. Noteworthy among these plants are *Afzelia*, *Nesogenes* and *Pipturus argenteus* which Baker suggests may be "a mere variety of *P. incanus*," a species of Seychelles, Malaya and Polynesia. The orchid is the only one recorded from these islands outside of Aldabra.

Cargados.

This group, and Albatross Island, is situated about 6° south of any of the other islands dealt with here, and about 4° north-east of Mauritius. According to Gardiner the "expedition landed on Establishment Island, where fish-curing was carried on. An attempt was being made to cultivate a few gourds and marrows, but the soil was evidently of the most inhospitable description; bois manioe, *Scaevola*, and bois de balais, *Erythroxylon*, alone flourishing. A few *Cocos* were coming up, and there was a small grove of *Casuarina*, a tree which seems to be capable of withstanding almost any conditions of drought and salinity. Here and there are clumps of low bush—*Erythroxylon* or *Tournefortia*—matted together by the liane sans fin, *Cassytha filiformis*."

Siren and two Bird Islands were also visited, but only ten kinds of plants were observed, including the above-named and *Pisonia*.

The Laccadive Islands.

As long ago as 1890 Sir David Prain published an account of the plants of the Laccadives, which is much more than a list, as it includes a careful analysis of the constituents of the vegetation and the general distribution of the probably indigenous species. The emuneration comprises 80 species, including 17 in the strictest sense cultivated, and the author at a later date kindly communicated the names of 20 additional species; all more or less widely distributed plants. The distribution table of the species is divided into 14 areas, including 6 insular ones, and shows at a glance that the plants are mostly nearly cosmopolitan in warm countries. There is no endemic species; all are Indian; all except 7 are recorded from Ceylon, and all except 12 are known to inhabit the Malay Archipelago. 55 of the 80 species are also recorded from Mauritius; 56 from continental Africa; 50 from Australia, and 45 from Polynesia. It should be borne in mind that there is nothing absolute about the foregoing figures; but they prove that the vegetation of the Laccadives is composed solely of widely dispersed elements. The absence of *Casuarina*, *Cycas*, and Orchids is noteworthy. Only two ferns, *Nephrodium molle* and *Nephrolepis tuberosa*, both most widely diffused kinds, have been collected. Concerning the origin of the flora, Prain estimates that it is wholly derived and the agencies of introduction four, namely, Man, 70 per cent.; the Sea, $21\frac{1}{4}$ per cent.; Birds, $3\frac{3}{4}$ per cent. and winds 5 per cent.

The Maldive Islands.

Willis and Stanley Gardiner's Botany of this Archipelago is very comprehensive and of the comparatively recent date of 1901, and really embodies all that was known of the Flora of the Maldives, Laccadives and Chagos Archipelago. The combined floras number 359 species of vascular plants, "of which about 245 are cultivated, or weeds of cultivation; 73 probably introduced by sea; 28 by birds, and 13 by wind. The flora of these islands is undoubtedly recent and derived from abroad."

Chagos Archipelago.

The flora of this group has been little investigated, as compared with that of the Laccadives and Maldives; but, so far as it is known, it is of quite the same character and composition. A sample is afforded by the following list of plants collected by Dr. A. G. Bourne in Diego Garcia in 1885. Absence of mangroves and presence of 6 species of ferns is noteworthy; but it should be borne in mind that the list has no claim whatever to completeness. Several evidently introduced species are omitted:—

Sida diffusa, Triumfetta procumbens, Suriana maritima, Terminalia Catappa, Morinda citrifolia, Guettarda speciosa, Vernonia cinerea, Ageratum conyzoides, Scaevola Koenigii, Ochrosia borbonica, Asclepias curassavica, Cordia subcordata, Tournefortia argentea, Ipomoea (Calonyction) quadriflora, I. biloba, Herpestes Monniera, Striga hirsuta, Lippia nodiflora, Stachytarpheta indica, Premna serratifolia, Boerhaavia diffusa, Pisonia inermis, Achyranthes aspera, Rivina laevis, Cassytha filiformis, Hernandia peltata, H. ovigera, Euphorbia pilulifera, Phyllanthus Niruri, Acalypha indica, Casuarina equisetifolia, Cyperus ligularis, Kyllinga monocephala, Fimbristylis glomerata, Digitaria horizontalis, Stenotaphrum complantum, Asplenium aequabile, A. longissimum, A. falcatum, A. Nidus, Nephrodium unitum, Pteris marginata and Psilotum triquetrum.

The plants of the foregoing list were the subject of a paper by the writer, for particulars of which see bibliography, and the specimens are in the Kew Herbarium. Noteworthy facts are the total absence of *Rubiaceae*, except the widely dispersed *Morinda citrifolia*, and *Guettarda speciosa*, and the presence of ferns.

Plants Reported from the Smaller Islands Indicated Below, but not from Aldabra.

Hibiscus Hornei—Gloriosa.
Oxalis nr. *O. villosa*—Cosmoledo.
Hippocratea sp. nova?—St. Pierre.
Canavalia obtusifolia—Assumption, Cosmoledo.
Afzelia bijuga—Coëtivy, Agalega.
Desmanthus virgatus—Providence.
Brexia madagascariensis—St. Pierre.
Terminalia Catappa—St. Pierre.
Barringtonia speciosa—Amirantes.
Cucumis trigonus—Gloriosa.
Vernonia cinerea—Amirantes.
Ochrosia borbonica—Providence.
Ipomoea glaberrima—Providence, Gloriosa.
Striga hirsuta—Providence.
Nesogenes prostrata—Agalega.
Celosia phytolaccifolia—Assumption.
Hernandia peltata—Providence, Amirantes.
Cassytha filiformis—Assumption, Cosmoledo, Astove, Providence, Gloriosa.
Pipturus argenteus—Agalega.

Disperis tripetaloides—Agalega.
Fimbristylis exilis—Assumption.
Eriochloa subulifera—Assumption.
Stenotaphrum clavigerum—Assumption.
Panicum assumptionis—Assumption.
Dactyloctenium pilosum—Assumption.

With some noteworthy exceptions* the plants in the preceding list are regional and also occur either in Seychelles or in the Mascarenes, or in both groups. *Nesogenes prostrata* is apparently confined to Agalega, as well as *Pipturus argenteus*, if this be really specifically different from *P. incanus*.

Desmanthus virgatus is an American colonist. The *Disperis* is also recorded by Baker from Mauritius and Bourbon.

From the general distribution of these twenty-five species of plants, their absence from Aldabra may be considered as accidental. The arboreus *Afzelia bijuga*, *Terminalia Catappa*, *Barringtonia speciosa*, *Ochrosia borbonica* and *Hernandia peltata* may have fallen before the axe in Aldabra for building purposes. Other woody species may have been used up for fuel, while a few inconspicuous herbs may have escaped the eye of collectors..

Summary.

For convenience it may be repeated here that Aldabra is an atoll, similar in size to the Isle of Wight, being approximately 22 miles by 8. It is oblong-oval in outline and the land rim is broken up into 4 islands of very unequal size. The lagoon is about 20 miles by 6, and contains numerous small islands. In area the atoll is about 120 square miles, of which about half is lagoon, and the surrounding land rim is from 12-15 ft. above high water line.

Aldabra is situated some 600 miles from the Seychelles Archipelago, 400 from East Africa, and 240 from Cape Amber, the nearest point of Madagascar, with a number of similar atolls and coral reefs to the immediate east. Assumption, the nearest island, is about 20 miles distant, but this is exceptional in not being a true atoll, having no central lagoon.

All writers agree that Aldabra is densely clothed with vegetation, and my task of classifying the various collections brings to light the fact that this vegetation is unusually rich and varied in elements for an atoll flora, and comprises herbaceous, shrubby and arboreous species. Excluding species evidently introduced through human agency, direct or indirect, but including a number of uncertain arrival, the Flora of Aldabra comprises over 170 species of flowering plants and one fern—*Acrostichum aureum*. This fern is almost cosmopolitan in tropical salt marshes, including Seychelles and the Mascarenes, but it has not been observed in any of the other small islands dealt with in

* The occurrence of four endemic grasses in Assumption is remarkable. Of these *Eriochloa subulifera* is an African or in a wider sense an Indo-African type, whilst *Stenotaphrum clavigerum* has its nearest ally in Madagascar (*S. costachyum*, Bak.), and *Panicum assumptionis* in Italian Somaliland (*P. pinifolia*, Chiov.). *Dactyloctenium pilosum* is a very marked member of the group represented by *D. aegyptiacum*, Willd.—O. S.

this paper. The species of flowering plants represent 127 genera and 54 families.

Similar proportions are characteristic of insular floras of both smaller and larger dimensions. Taking Bentham and Hooker's classification in a somewhat modified or extended sense, these 54 families constitute about one-fourth of the generally recognised families of the phanerogamic or flowering plants of the world. Over one-third (19) of these families are represented by only one species each, and, it follows, by only one genus each. 15 families are represented by only 2 species each, and 5 by 3 species, whilst 6 others number 4 species each. These 5 families account for 88 species or considerably more than half of the total number. For the rest, the Gramineae number 14 species; the Rubiaceae 15, and the Leguminosae 12. The average of species to a genus is rather less than 1·4 in the whole flora.

Noteworthy among the genera represented by only one species in Aldabra are *Erythroxylon*, *Ochna*, *Macphersonia*, *Sideroxylon*, *Jasminum*, *Salicornia*, *Viscum*, *Angraecum*, *Dioscorea*, *Lomatophyllum*, *Pandanus* and *Acrostichum*. Most of the genera named have a wide geographical area; but *Macphersonia* and *Lomatophyllum* are regional. There is only one genus of phanerogamia confined to the small islands under consideration, namely, *Apterantha* in Aldabra. The small number of *Compositae* (four) and the absence of *Labiatae* are remarkable; and the large and almost universally spread *Scrophulariaceae* are present only in the cosmopolitan *Herpestis Monnieria*.

The presence of *Loranthus* and *Viscum* in Aldabra, as well as of the Orchids, *Acampe* and *Angraecum*, is specially interesting because these elements are apparently wanting in all the other islands, except Agalega, of the Seychelles area, outside of the Seychelles Archipelago proper. *Disperis tripetaloides*, a terrestrial orchid, is recorded by Baker from Agalega. *Disperis* is mainly South African with a few Mascarene and Indian species. Orchids, it may be mentioned in passing, are exceedingly rare in remote islands of small and moderate dimensions, or entirely absent. Thus there is none in the islands of the South Indian Ocean from St. Paul and Amsterdam and Kergulen to the Crozets and Heard Island. There is none in the south Atlantic Islands from Ascension to Tristan da Cunha and South Georgia, save four species in the Falklands. Turning to the North Pacific, the Sandwich Islands possess only 3 species of Orchids; Guadaloupe Island, off the coast of Lower California, none; Galapagos, 2 or 3; Juan Fernandez. none. On the other hand, the islands to the south of New Zealand include orchids in decreasing numbers southward; the Auckland group sheltering about a dozen species; the Campbell half-a-dozen, and the southernmost Macquarie Island none at all. Absence from the last-named island is not due to unfavourable climatic conditions. About a dozen species of Orchids inhabit Seychelles and they are numerous in the Mascarenes. On the other hand, the distant Laccadives, Maldives and the Chagos Archipelago are also destitute of this family.

The large, almost cosmopolitan family of *Rubiaceae* consti-

tutes the predominating element in the woody vegetation of Aldabra both as to number and diversity of genera and number of species; but probably they are not so conspicuous, even collectively, in the scenery as the Mangroves, the Figs and *Euphorbia Abbottii*.

The conspicuous coco-nut plantations are purposely left out of consideration. There are 15 species of Aldabra *Rubiaceae*, belonging to 10 genera, of which 5 range beyond the African region, and 1, the large genus *Psychotria*, is common to the tropics of both hemispheres. *Polysphaeria*, *Triainolepis*, *Rutidea*, *Tarenna* and *Tricalysia* are limited to the African region, including Madagascar and the Mascarenes.

A list of certainly introduced plants collected in Aldabra is given in a preceding section. It is not offered as exhaustive and calls for no special remark except that there is no evidence of any of these plants being common or over-running the island.

Particulars are given in a condensed form of the Flora of the islands of Assumption, Cosmoledo, Astove, Farquhar, Providence, St. Pierre, Gloriosa, Amirantes, Coëtivy, Agalega, Cargados Carajos, the Laccadives, Maldives and the Chagos Archipelago; affording data for some interesting comparisons.

The list of plants occurring in these islands (excluding Cargados, the Laccadives, Maldives and Chagos) and hitherto not found in Aldabra is perhaps the most interesting feature. It consists of 23 species, of which about half are widely spread littoral and insular plants, accidentally absent from Aldabra, or used up by the settlers for fuel or building purposes; for example, *Afzelia bijuga*, *Terminalia Catappa*, *Barringtonia speciosa*, *Ochrosia borbonica* and *Hernandia peltata*. In a different category belong *Hisbiscus Hornei*, *Oxalis* sp. *Hippocratea* sp., *Brexia*, *Nesogenes prostrata* and *Disperis*; but they are all plants of the region outside of these islands.

In conclusion, the data collected point clearly to a common origin of the Flora of Aldabra and the neighbouring islands; and that flora is essentially African, and almost without any infusion of an Asiatic element, or, to be more precise, Malayan element. By Malayan element I mean the presence of representative species of such genera as *Nepenthes* and *Amaracarpus* (*Rubiaceae*), which have their greatest concentration in Malaya. Such an element exists in the Flora of Seychelles and in the Mascarene Flora; but it is difficult, indeed impossible, to estimate the relative importance of the various elements of a flora in attempting its history. It is easy to compile lists of plants and show their present distribution; but how and in what direction this distribution has been effected is beyond the wisdom of man to fix from available data. It is easy to generalise and theorise, and it is easy to speculate on the course of evolution and the sequence of changes in vegetation; but a satisfactory history of events is perhaps unattainable. Indeed, the more I learn of the present distribution of plants the more I am puzzled as to how it has been brought about. Of course, there is no disputing the fact that much has been accomplished and placed beyond doubt, but much more remains to be discovered before we can arrive at satisfactory results. Taking the Flora of

Aldabra for example, present conditions seem to favour, in part, that it is a remnant of a former more extensive flora, but on the other hand the presence of the component elements might be accounted for through the action of various agencies. I have elsewhere* expressed the opinion that the assumed endemic plants of Aldabra may be proved to exist in Madagascar or elsewhere. This aspect of the subject might be pursued almost indefinitely, but I prefer leaving the facts to the interpretation of more skilled minds.

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V.—THE RAIN TREE OF HIERRO, CANARY ISLANDS.

(*Oreodaphne foetens.*)

J. Hutchinson.

The island of Hierro, the most western of the Canaries, was of considerable interest to the early voyagers, on account of the supposed existence of a wonderful tree called *Garoe* or *Til*, accredited with the miraculous power of supplying the whole of the inhabitants with sufficient water for their maintenance. The water supply of dry volcanic superstructures like the Canary Islands, being of such vital importance to the inhabitants, it is natural that any phenomenon, besides rain, which provided the islanders with additional water, was regarded as the gift of Providence and venerated and worshipped accordingly. So it was in regard to this celebrated tree, as will be evident from what follows.

Whilst it is probable that the Canary Archipelago was known

to the earliest voyagers, the Phoenicians and the Carthaginians, many hundreds of years before the Christian era, we know for certain that it was visited by Roman navigators during the reign of Juba II, King of Mauritania (about 25 B.C.). The Romans regarded the islands as being the western boundary of the world. Pliny gives us Juba's† account of them, of which the following is a free translation: "Juba learned much about the Fortunate Islands [=Canary Islands] by diligent enquiry; they lie . . . . 625 miles from the Purpurariae [=Madeira, etc.], and to arrive there one must sail 250 miles west and then for 75 miles more bend one's course eastward. The first island is called *Ombrios*, where there are no signs of habitations; *among the mountains there is a pool, with trees resembling the Ferula plant, from which water is obtained; from the black trees the water is bitter, from the whiter ones sweet to the taste.* A second island is called *Junonia*, where there is a little house built of stone. Near to the latter there is a smaller island of the same name. And next in order there is an island called *Capraria*, which is full of large lizards. Within view of these islands is *Nivaria*, so named from its perpetual covering of snow and clouds. The next island is called *Canaria*, from its huge and numerous dogs, two of which King Juba brought away with him; here there are remains of dwellings. Moreover, in all these islands there is an abundance of fruit trees and birds of all kinds, as well as date-palms and pine-kernels. There is also plenty of honey, besides Papyrus and fresh-water fishes."

According to Hardouin‡ the larger *Junonia* was the island of *Gomera*, the smaller one near it a more or less submerged rock; *Capraria* was Palma; *Nivaria* the island of Tenerife; *Canaria* the Grand Canary of to-day, and *Ombrios* the island of Hierro. Another authority§, however, considered the larger *Junonia* to be Palma, the lesser one Gomera, but agreed with Hardouin as to *Ombrios* being the modern Hierro, the only one which immediately concerns us here. There are also other interpretations.

It is noteworthy that the name applied by the Romans to the last-mentioned island had some association with water supply, ομβρος being the Greek for rain. The modern Spanish name

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* See Samler Brown, Madeira, Canary Islands and Azores, ed. x. p. g. 8 (1910).

† Pliny's text is as follows, as given in the Hardouin Edition, Liber vi. Cap. 37: "Juba de Fortunatis ita inquisivit: sub meridie quoque positas esse prope occasum a Purpurariis DCXXV mille passuum sic ut CCL supra occasum navigetur deinde per LXXV mille passuum ortus petatur. Primum vocari Ombrion, nullis aedificiorum vestigiis; habere in montibus stagnum, arbores similes ferulae, ex quibus aqua exprimatur, ex nigris amara, ex candidioribus potui jucunda. Alteram insulam Junioniam appellari in ea aediculam esse, tantum lapide exstructam. Ab ea in vicino eodem nomine minorem. Deinde Caprariam lacertis grandibus refertam. In conspectu earum esse Nivariam, quae hoc nomen accepit a perpetua nive nebulosam. Proximam ei Canariam vocari a multitudine canum ingentis magnitudinis, ex quibus perducti sunt Jubae duo: apparentque ibi vestigia aedificiorum. Cum autem omnes copia pomorum et avium omnis generis abundent, hanc et palmetis caryotas ferentibus ac nuce pinea abundare. Esse copiam et mellis. Papyrum quoque et siluros in amnibus gigni."

‡ Hardouin, l.c.

§ P. Galindo and Nunez de la Penna.

Hierro, according to Webb and Berthelot*, is derived from *hero*, which signified fountain or spring in the language of the Bimbaches, the original inhabitants now long disappeared. These authors state, on the authority of Viana, that the primitive people of Hierro called the wells or cisterns, which they used for conserving rainwater, *heres*, and that this designation was still in use (*i.e.*, in 1839). This explanation of the origin of the name Hierro seems to discredit sufficiently the views taken by some writers on the Canaries that *Hierro* must mean the same as the French rendering of the word as *Fer*, which, however, has nothing to do with *fer* (iron).

In his excellent guide-book to Madeira, Canary Islands and Azores (1910), Samler Brown says of Hierro: "The coast is steep and uninviting, all the anchorages being mere open roadsteads. The cliffs rise so suddenly from the sea that there is no room for houses on the coast and consequently no seaport town to find a means of building a mole . . . . The interior is a sort of tableland along which most of the paths are conducted, and where most of the inhabitants own patches of land, on which they grow cereals, pasture their cattle, and where they live during the harvesting season . . . . The mountains, of which the Alto del Malpasa (4990 ft.) is the highest, are only partially wooded, and there is far less sylvan scenery than is to be found in the other islands of the western group, although in some places, and more particularly in the neighbourhood of El Golfo, there are a fair number of trees. There are practically no springs and the people depend for water on the rain, which is preserved in tanks. The air which passes, however, is sufficiently laden with moisture. Were the question properly studied and plantations made in judicious positions, it is probable that an increased supply could be obtained. On the arrival of the Spaniards there appears to have been a tree near Valverde called *El Garoe*, which, according to legend, distilled enough water from its leaves to supply all the people with what they required."

This tree, or perhaps more likely several trees, is supposed to have been *Oreodaphne foetens*, Nees (*Ocotea foetens*, Webb & Berthel.),† a species of laurel not now recorded from the island of Hierro. It is, however, still fairly common in the islands of Tenerife, Grand Canary and Palma, and in Madeira, where it occurs amongst other evergreens of the "laurel forest" or "Monte Verde," so characteristic of the cloud region of the Canaries. The date-palm mentioned by Pliny was no doubt the distinct endemic species *Phoenix canariensis*, Hort., considered by some authors to be a variety (var. *Jubae*) of the common date-palm, *P. dactylifera*, Linn. The pine-kernels were those of the endemic *Pinus canariensis*, C.Sm., which in former days must have occupied a much greater area of the islands than at the present time (see *Kew Bull.* 1918, 1-3).

In the narrative of Sir Richard Hawkins‡ on his voyage to

* Webb and Berthelot, Hist. Nat. Isles Canar. ii. pt. i. 151.

† See Buch, Allgem. Ubers. der Fl. Canar. Insl. 341.

‡ See Haklutus Posthumus or Purchas His Pilgrimes, vol. xvii. 64.

the South Sea (1593) we get the following account of Hierro: "Two things are famous in these islands, the Pike (Peak) of Tenerife . . . . The other is a tree in the Island of Fierro, which some write and affirme, with the dropping of his leaves, to give water for the sustenance of the whole Iland, which I have not seene, although I have beene on shore on the Iland: but those which have seene it, have recounted this mysterie differently to that which is written, in this manner; That this Tree is placed in the bottome of a Valley ever flourishing with broad leaves, and that round about it are a multitude of goodly high Pines, which over-top it, and as it seemeth, were planted by the Divine providence, to preserve it from Sunne and winde. Out of this Valley ordinarily rise every day, great vapours and exhalations, which by reason that the Sunne is hindered to worke his operation, with the height of the Mountaine towards the South-east, convert themselves into moisture, and so bedew all the trees of the Valley, and from those which over-top this Tree, drops downe the dew upon his leaves, and so from his leaves into a round Well of stone, which the Naturals of the Land have made to receive the water; of which the people and cattell have great reliefe: but sometimes it raineth and then the Inhabitants doe reserve water for many dayes to come in their Cisternes and Tynaxes, which is that they drinke of, and wherewith they principally sustaine themselves."

To this account there is a footnote as follows: "Of a tree in Fierro: One M. Lewis Jackson, now dwelling in Holborne, told me that A. 1618 he had beene in this Iland, and seene this Tree, which he thus described; It is as big as an Oake of middle size, the barke white like Hardbeame; sixe or seven yards high, with ragged boughs; the leafe like that of the Bay, white on the bottome and greene on the other side. It beareth neither fruit nor flower. It is situate in the declivitie of a Hill; in the day it is withered, dropping in the night (a cloude hanging thereon) yeelding water sufficient for the whole Iland; which containeth 8000* soules, and above 100,000* beasts, camels, mules, Goates, &c. It falls into a Pond made of bricke, floored with stones very thight, by pipes of Lead conveyed from the Tree to it, and thence divided into several Ponds through all the Iland. They which dwell up-hill fetch it in barrels. They water therewith also their corne-grounds. The Pond holds 20,000* tuns, and is filled in a night. He added a report (perhaps devised to keepe off busie fingers, or with busie tongues to multiplie wonders) that the Moores having taken that Iland from the Christians, went to fell that Tree, but each blow recoyled on the striker."

A very good account of the Rain-tree of Hierro was found in a Spanish MS.† discovered in the Island of Palma

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* There is no doubt very great exaggeration here.

† Dr. G. V. Perez, quoting the Spanish historian Viera y Clavijo, informs us that the name of the author of this MS. was Father Abreu Galindo. We have not seen a complete copy of the published work, but only a typed extract relating to the Rain-tree from a copy of the book kindly lent to Kew some time ago by Sir Daniel Morris.

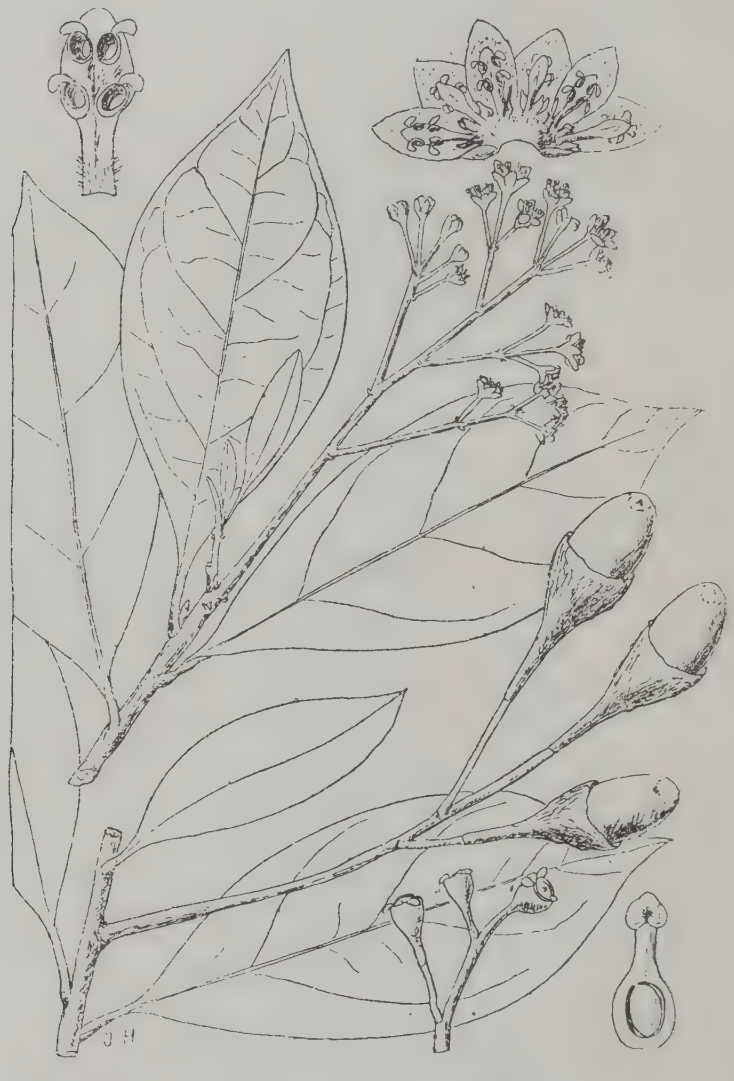
and was translated into English and published by George Glas* in 1764 (London). Its title is "The History of the Discovery and Conquest of the Canary Islands: with an enquiry into the Origin of the Ancient Inhabitants." Glas, who had himself travelled much in the Canaries, but had not visited Hierro, writes thus about the island and its water supply:—"This island produces better grass, herbs, and flowers than any of the other islands, so that bees thrive and multiply here extremely, and make excellent honey. The wine of Hierro is poor, weak, and bad, insomuch that the natives are obliged to distil the greatest part of it into brandy. There are only three fountains of water in the whole island, one of them is called *Acof*, which, in the language of the ancient inhabitants, signifies river; a name, however, which does not seem to to have been given to it on account of its yielding much water, for in that respect it hardly deserves the name of a fountain. More to the northward is another, called *Hapio*; and in the middle of the island is a spring, yielding a stream about the thickness of a man's finger. This last was discovered in the year 1565, and is called the Fountain of Anton Hernandez. On account of the scarcity of water, the sheep, goats, and swine here do not drink in the summer, but are taught to dig up the roots of fern, and chew them to quench their thirst. The great cattle are watered at those fountains, and at a place where water distils from the leaves of a tree. Many writers have made mention of this famous tree; some in such a manner as to make it appear miraculous; others again deny the existence of any such tree, among whom is Father Feyjoo, a modern Spanish author, in his Theatro Critico. But he, and those who agree with him in this matter, are as much mistaken as they who would make it appear to be miraculous. This is the only island of all the Canaries which I have not been in; but I have sailed with natives of Hierro, who, when questioned about the existence of this tree, answered in the affirmative."

Glas then goes on to give an account of the Rain-tree from the Spanish manuscript, as follows:—"The district in which this tree stands is called Tigulahe, near to which, and in the cliff or steep rocky ascent that surrounds the whole island, is a narrow gutter or gully, which commences at the sea, and continues to the summit of the cliff, where it joins or coincides with a valley, which is terminated on the steep front of a rock. On the top of this rock grows a tree, called, in the language of the ancient inhabitants, *Garse*†, *i.e.*, Sacred or Holy Tree, which for many years has been preserved sound, entire, and fresh. Its leaves constantly distil such a quantity of water as is sufficient to furnish drink to every living creature in Hierro; Nature having provided this remedy for the drought of the island. It is situated

* George Glas (1725–1765), a native of Dundee, made several voyages to the West Coast of Africa and the Canary Islands. On some paltry excuse he was imprisoned in Tenerife in 1764 for nearly a year, and on being released took passage for England on board the English barque *Sandwich*. He was killed during a mutiny on board the ship off the coast of Ireland. (See Dict. National Biography).

† This is probably a misprint for *Garoe*.

about a league and a half from the sea. Nobody knows of what species it is, only that it is called *Til*. It is distinct from other trees, and stands by itself; the circumference of the trunk is about twelve spans, the diameter four, and in height from the ground to the top of the highest branch 40 spans; the circumference of all the branches together is one hundred and twenty ft. The branches are thick and extended; the lowest commence



* *Oreodaphne foetens*, Nees.

about the height of an ell from the ground. Its fruit resembles the acorn,† and tastes something like the kernel of a pine-apple,‡ but is softer and more aromatic. The leaves of this tree resemble those of the laurel, but are larger, wider, and more curved; they come forth in a perpetual succession, so that the tree always remains green. Near to it grows a thorn, which fastens on many of its branches and interweaves with them; and at a smaller distance from the *Garse* are some beech-trees,

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* See the great resemblance to an acorn in the accompanying sketch of *Oreodaphne foetens*.

† Glas has a footnote here saying "Not the anana, but the fir or pine tree pear, nut, or apple [= seed]. Those of Britain have nothing in them; but the pine-apples [= pine seeds] in Spain, and some other countries, contain a kernel of an agreeable taste."

bresos,* and thorns. On the north side of the trunk are two large tanks or cisterns of rough stone, or rather one cistern divided, each half being 20 ft. square and 16 spans in depth. One of these contains water for the drinking of the inhabitants and the other that which they use for their cattle, washing, and such like purposes. Every morning near this part of the island, a cloud or mist arises from the sea, which the south and easterly winds force against the fore-mentioned steep cliff; so that the cloud, having no vent but by the gutter, gradually ascends it, and from thence advances slowly to the extremity of the valley, where it is stopped and checked by the front of the rock which terminates the valley, and then rests upon the thick leaves and wide-spreading branches of the tree, from whence it distils in drops during the remainder of the day, until it is at length exhausted, in the same manner that we see water drip from the leaves of trees after a heavy shower of rain. This distillation is not peculiar to the *Garse*, or *Til*, for the *bresos* (*Erica arborea*), which grow near it, likewise drop water; but their leaves being but few and narrow the quantity is so trifling, that though the natives save some of it, yet they make little or no account of any but what distils from the *Til*, which, together with the water of some fountains, and what is saved in the winter season, is sufficient to serve them and their flocks. This tree yields most water in those years when the Levant or easterly winds have prevailed for a continuance; for by these winds only the clouds or mists are drawn hither from the sea. A person lives on the spot near which this tree grows, who is appointed by the Council to take care of it and its water, and is allowed a house to live in, with a certain salary. He every day distributed to each family of the district seven pots or vessels full of water, besides what he gives to the principal people of the island."

Dr. G. V. Perez has interested himself in the Hierro Rain-tree, and has kindly forwarded to the Director an abridged translation of an article from a Madrid paper, "Las Canarias," for November, 1917, entitled "Los Arboles Santos de Canarias," by R. Castellanos. "Hierro had no springs, but a Holy tree called Garoe, the existence of which being so marvellous has been denied to many, but is now admitted to have actually existed. The Rev. Andres Bernaldez, in his Chronicle of the Catholic Kings, says that in the Island of Hierro there is a marvel of the world; the inhabitants drink of water sweated from the leaves of a tree; there is a tree after the manner of an *Alamoyes* (Dr. Perez suggests this may have meant an *Ulmus*) alive still, that never loses its leaves, and its fruit is alike to acorns, which are bitter as gall if eaten; they are medicinal and do no harm; the height of the tree is that of $1\frac{1}{2}$ lanza (a wariance); it has large branches, and takes two men to embrace the trunk, which sweats miraculously drops of water into a receptacle placed at a lower level, so that not a drop of water is lost. From there the inhabitants get their water to drink, there being then about eighty families which got their supplies from it; the leaves are like those of a laurel but a little larger; there is not

* *Erica arborea.*

in all the seven islands another tree of that nature, nor in the whole of Spain, nor is there living man who has seen another anywhere else; and for that reason it appears to be a mystery of God who wished to supply water in such a manner as a consolation to the people who should have been thrown into that island where there never were wells or springs."

In regard to the identity of the *Garoe* or *Til*, Dr. G. V. Perez writes to the Director: "I feel positive that the tree in question was *Orcodaphne foetens*, Nees, chiefly because of the fruit, which is so like that of the Oak, with which the first Spanish settlers were familiar, different species of Oak being common in Spain. Among the different species of *Lauraceae* peculiar to the Atlantic flora and common in our evergreen forests, the one which has largest leaves, and where water appears to me to be more abundantly condensed is the tree in question."

Dr. Perez further writes that "Viera y Clavijo, the historian of the Canary Islands, in repeating the description from Father Juan de Abreu Galindo, recognised that the *Garoe* only owed its distilatory virtues to its frondosity, to its advantageous position and to the mountain mists that formed about it daily and that there was nothing supernatural in it; and the explanation of Father Abreu Galindo, who saw it, measured it and observed the tree himself, is enough to explain everything without appealing to the miraculous."

Although the Bimbaches of Hierro were friendly to the Spanish invaders led by Jean de Bethencourt at the beginning of the 15th century, it is clear that they did not wish them to remain long on the island. This may be gathered from the following story relating to the rain-tree published by Claude Duret in his *Histoire Admirable* (1605); Chapter xv., accompanied by a picture (here reproduced at Fig. A), is devoted

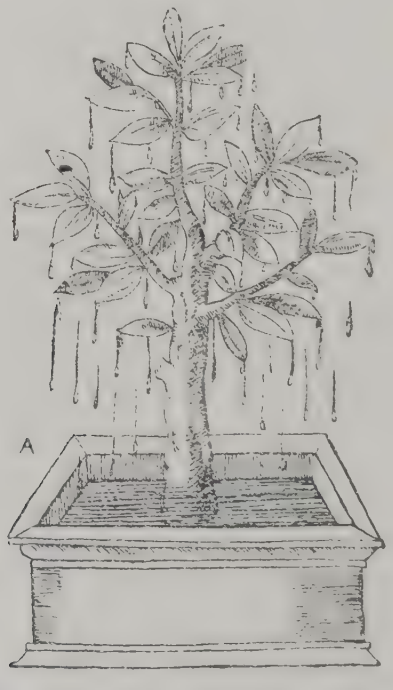

Fig. A.—The Canary Rain Tree: from Duret, *Histoire Admirable* (1605).

to an account of the Hierro rain-tree, and bears the following heading: "D'un certain Arbre port-eaux, c'est a dire qui fournit

d'eaux aux habitans d'une Isle." The substance of the story is as follows:—When the Spanish conquerors appeared in Hierro the natives covered their sacred rain-tree with branches, reeds, and other things, hoping by this ruse that the invaders would not see their water supply and would leave the island on account of its scarcity. The secret was, however, divulged by one of the Bimbache maidens, who fell in love with a caballero, and showed him the tree and its tanks of water. This led to a quarrel with the Spaniards, who carried off a number of the islanders as slaves, and on the departure of her lover the young woman was condemned to death.

It is interesting to note that with all its faults the picture given by Duret shows he had a good idea of the shape of the leaves, and also some hazy conception of the relationship of "drip-tips" to condensed moisture. That the Canary Rain-tree was well known and an object of considerable interest to botanists of the early 17th century is clear from the fact that a picture of the plant formed the frontispiece of Bauhin & Cherler's Historia Plantarum Generalis (1619), a copy of which we reproduce at Fig. B. The same drawing is reproduced by Parkinson (Theatrum Botanicum, 1640), who refers to Jackson's account mentioned above.

According to Dr. Perez, quoting Bartolomé Garcia del Castillo's book "Noticias del Hierro," this wonderful tree was blown down in a storm on the 12th June, 1612. He adds that in 1753 an enquiry about the tree was made in Hierro, and testimony was received from witnesses 80 to 95 years of age, who were all agreed about the tree having existed and they pointed out without hesitation where it grew, showing the remains of the tanks at its foot.

Fig. B.—Frontispiece of Bauhin & Cherler, *Historia Plantarum Generalis* (1619).

The serious effect on the climate following the destruction of mountain forests on the islands of St. Helena and Jamaica

has been well shown by Sir Daniel Morris.* In his lecture† before the Society of Agriculture and Commerce at Kingston, Jamaica, he quoted some correspondence from South Africa mentioned in J. C. Brown's Forests and Moisture (1877), p. 148, which we give in its entirety: "This season has been unusually hot and dry along the coast, and all around Graham's Town we have been unable to grow anything all this summer for want of rain. The springs are all failing. You may, perhaps, know the place of Mr. J. J. Stone, on the top of the hill on the Cowie Road, toward the sea, marked by a quantity of gum trees, on the ridge of the high hills to the south-east of Graham's Town. Well, all through the summer we had only light, misty rain, just enough to dampen the grass and not enough to wet the ground; but these trees of Mr. Stone's have there converted the mist into rain. They have scarcely felt any effects of dry weather; the vegetables and flowers have there grown all the summer without watering; there the tanks have always been full; and that is the only place of which I have heard, that it has been so within five and twenty miles of Graham's Town."

In November, 1901, Dr. Marloth,‡ of Cape Town, conducted some experiments for ascertaining the amount of moisture deposited from the south-east clouds, which appear around Table Mountain during the dry and practically rainless summer months, forming the well-known "Table-cloth." His results were little short of sensational and "excited considerable astonishment and wonder."§ Dr. Marloth placed two rain gauges on the top of Table Mountain about midway between the east and west ends of the upper plateau. One gauge was left open in the usual way, the other "surmounted with a framework representing a bunch of reeds."‖ The first experiments not proving satisfactory, owing to a combination of circumstances, Dr. Marloth continued with the experiment on December 21, 1902. "The first reading of the season was made on January 1, 1903, when it was found that the open gauge contained nothing, whilst the other one showed 15·22 in. of moisture, and that for a period of 10 days. The next reading took place on the 11th of January. The open gauge was again dry, the other one showing 14·64 in. In 21 days the reeds had condensed moisture corresponding to 29·86 in. of rain, while the open gauge showed nothing. . . . . The observations came to an untimely end on the 15th of February, because a week afterwards the gauges were found to be destroyed. . . . . The result is that . . . . . in 56 days, the gauge with the reeds had condensed a quantity of moisture equivalent to 74·87 in. of rain, and that quantity was recorded although the last three times the gauge had overflown.

"If one considers that the average annual rainfall at Cape

* A Report upon the Present Position and Prospects of the Agricultural Resources of the Island of St. Helena (Colonial Office, Jan. 1884).

† Lecture on the Occurrence of Droughts, Kingston, Jamaica, July, 1885.

‡ Marloth in Trans. S. Afr. Phil. Soc. xiv. 403–408 (1903).

§ C. M. Stewart, l.c. 413.

‖ *Restionaceae.*

Town (Town House) is 23·81 in., at the Royal Observatory 27·95, and at Newlands (Bishop's Court) 55·54, which is almost the highest record for any low-level station in the Cape Colony, the extraordinary nature of these results is obvious, and it is not surprising that the vegetation of our mountains is so different from that of the hills."

Dr. Marloth's experiments showed that the summer of the plants growing within the area of the cloud belt was not dry, but that their environment approximated more nearly to that of a swamp, a permanent swamp in winter, due to rainfall, a periodical swamp in summer, due to clouds; further, that these conditions explained the presence of "a luxuriant and thickly set vegetation on the upper parts of these mountains; why shrubs, 6 to 8 ft. high, crown the summit of Devil's Peak; why thickets of beautiful heaths, 4 to 5 ft. high, grow on the top of Jonkershoek peaks; why there is a little forest of yellow wood, *Kiggelaria*, *Olinia*, and other trees on the top of Klapmuts Hill; why the cedar grows only at a certain level on the Cedarbergen, why Proteas and heaths abound on the Zwartebergen, and why there are little lakes, even late in summer, on the top of Table Mountain as well as close to the summit of Dutoit's Peak."

Objections to Dr. Marloth's rough-and-ready methods of investigation were at once raised by Mr. Charles Stewart,* which were, perhaps, justified from a meteorological standpoint; but as Sr. Marloth stated in his reply,† after two years' further experiments, he did not look upon the figures as being equivalent to records of rainfall, for during rain a great deal of water runs off the bare rocks and reaches the streams immediately, whilst water condensed from the clouds is captured only where sufficient vegetation exists, which, on the other hand, retains a large proportion of it in the spongy root system. He stated further that there could be no question that the vegetation of the South African mountains was a very important factor in the regulation of the water supply of the springs and streams, and that this influence was exerted in two ways, firstly, by capturing a not inconsiderable amount of moisture from the south-east clouds, which would escape if the mountains were formed by bare rocks only; and secondly, by protecting the water which has accumulated in the soil and the rocks against the sun and consequent evaporation.

There seems to be no doubt, then, that vegetation plays a very important part in the collection and retention of moisture under certain conditions, and the laurel forest of the Canaries probably performs this function in just such a manner as do the trees in the South African mountains. I have quoted Dr. Marloth at considerable length, because, as he says, his earlier experiments were apparently the first of their kind for determining the influence of mountain vegetation on the collection and retention of moisture from passing clouds; and further, to bring to the notice of the inhabitants of the Canary Islands how vital it may be for them not only to preserve, but, if possible, to augment

* S. Afr. Phil. Trans. l.c.

† l.c. xvi. 103.

the area of evergreen vegetation within the region of the periodical cloud belt. For instance, experiments might be made with the various species of trees and shrubs already growing there in order to prove which were the most efficacious in the condensation of moisture from the clouds. It would seem very probable that judicious planting of such vegetation at suitable altitudes might so increase the amount of water supply, as to make possible a great extension of the area of cultivation of the banana, for which the soil of the Canaries is so suitable, and for various other crops for which the water supply at present is insufficient.

Kew is indebted to Dr. G. V. Perez, of Santa Ursula, Tenerife, for notes on the Rain-tree in correspondence with the Director, and the writer tenders his thanks to his colleague, Mr. S. A. Skan, for indicating some of the literature.

VI.—MISCELLANEOUS NOTES.

Mr. Frederick Flippance, formerly a member of the gardening staff, and for some time a Temporary Assistant in the Herbarium, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Assistant Curator of the Botanic Gardens, Singapore.

Arthur Eckley Lechmere.—The news of the untimely death of Dr. A. E. Lechmere on February 14th, following so soon after his return to this country from Ruhleben, where he was interned for over four years, has been received with the deepest regret by those who shared with him the hardships of the life in the internment camp at Ruhleben and by all who were associated with him during his studies in this country and in France before war broke out. By his death biological science loses one of the most promising and enthusiastic of the younger generation of workers at the very threshold of his career.

Arthur Eckley Lechmere was a member of the family of that name long associated with Fownhope, Herefordshire, and was born 34 years ago. Following the death of his parents during his boyhood he ultimately settled in Bristol, started training as an electrical engineer and entered the University College there in 1905, as a student in the Faculty of Engineering. He soon transferred his attention to natural science and quickly developed that passion for biology which determined the subsequent course of his life and which in the end spurred him to those achievements in the internment camp which have excited the admiration and wonder of all who have been privileged to have been brought into touch with them. Under the stimulating influence of Professor J. H. Priestley, who at that period was in charge of the Botanical Department at University College, Bristol, Lechmere adopted botany as his chief subject and sought the earliest opportunity of engaging in research in that subject. In 1909 he recived the London B.Sc. Honours degree in Botany

and the following year secured the Bristol B.Sc. degree for research in the same science. From that period his studies and inclinations lay chiefly in the direction of mycology.

For some time previously his preference for this branch of botanical science had been fostered by close connection with work on various micro-organisms in progress at the National Fruit and Cider Institute, Long Ashton, near Bristol. The association of that institution with Bristol University was then under consideration, and shortly afterwards it was attached to the University to serve as the Agricultural and Horticultural Research Station for the West of England. Financed by the Board of Agriculture and Fisheries with the aid of grants from the Development Fund, the station was immediately considerably extended and its scope of work widened to include the subject of the treatment of plant diseases. Lechmere therefore resolved to concentrate on the study of plant pathology and proceeded to qualify for an appointment on the staff there as mycologist.

With that object he went to France after taking his Bristol degree, entered the University of Paris and studied mycology under Professor Mangin at the Cryptogamic and General Pathology Laboratory of the Pasteur Institute. Before the end of his first year in Paris an opportunity of widening his training in preparation for his life-work was afforded by the grant of a Research Scholarship by the Board of Agriculture and Fisheries for a period of three years. It was characteristic of his high ideals as to the thoroughness of preparation needed for scientific investigation that he chose to continue his pursuit of knowledge in the capacity of a student for the three following years rather than accept the post which was already open to him. The first year of his scholarship was spent in Paris to complete the course which he had originally mapped out for himself and at its conclusion he was awarded the degree of Doctor of Science of that University. The remaining period of his scholarship was passed, first in London at the Imperial College of Science, and subsequently at Munich in Professor von Tubeuf's laboratory.

His appointment as mycologist at the Long Ashton Research Station was dated to start on September, 1914, and it was his intention to leave Germany the previous month. The threatening nature of European affairs caused him to hasten his departure; but events moved too rapidly and he failed to reach the German frontier at Lake Constance until twenty-four hours after the last British civilians were permitted to leave. He was for a short time detained in the neighbourhood then thrown into prison temporarily and subsequently transferred to the salt mines in Bavaria, where he was incarcerated until November of the first year of hostilities. There he suffered the severest hardships, accentuated by serious illness, and there is little doubt that this portion of his internment was largely responsible for the undermining of a constitution which was never of the best. From the salt mines he was sent to Ruhleben. In spite of the rigour of the conditions in the race-course camp, especially in the early days, the change was a welcome one

and led him to the accomplishment of what must be regarded as the great work of his all-too-brief life, which earned for him the love and devotion of all his fellows there.

The story of the stern years at Ruhleben may be more fitly left to be told by those who were his companions during that time. One need only note here, that, notwithstanding the appalling trials and surroundings, and handicapped by more or less continuous ill-health, he succeeded, as he always did, in extracting the most and the best out of life and at the end was able to look back upon it as the finest portion of his career and, in his own words, as by far the shortest four years which he had ever spent.

He was able to return to England early last December and after a brief holiday started work at Long Ashton at the beginning of February. Within a week he contracted a severe chill. Pneumonia supervening, he succumbed after a few days' illness.

His death causes a gap in the ranks of the young biologists of this country at a time when men of his calibre are most needed. It is given to few men of his years to attain the same degree of proficiency in his special subject and with it to possess the impelling personality which marked him out for a foremost place in whatever field of action he chose to select. Ruhleben provided him with his opportunity and revealed him as a leader among men. Ruhleben also has shown the measure of the loss science has sustained.

In his brief career, almost entirely spent in preparatory work, the volume of achievement in the way of original investigations was necessarily small; but he was able, nevertheless, to publish a short series of mycological papers embodying the results of his work in Bristol and Paris, which indicate his aptitude for research and his wide range of knowledge. At Bristol he was largely occupied with a study of the methods of reproduction in the *Saprolegniaceae*, an account of which appeared in the "New Phytologist" in 1911. Simultaneously he collaborated with Professor Priestley in an investigation on a bacterial disease of swedes, the results of which were published in the "Journal of Agricultural Science" in 1910. In Paris he undertook the examination of certain fungi obtained from the Côte d'Ivoire, by Chevalier, and published descriptions of two forms, *Pionnotes viridis* and *Peristomium desmosporum*, nov. spec., in the "Comptes Rendus" in 1912 and the "Bulletin de la Société mycologique de France" in 1913. His main achievement for science, however, was the development of the school of biology and the equipment of laboratories amid the almost insuperable difficulties of the camp at Ruhleben. The extent of the service which he rendered there can only be fully appreciated by those who worked with him during those four full years; but by them his enthusiasm for science and stimulating influence will never be forgotten and through them the value of his work will be passed on.

To those of us who were privileged to have been associated with him in his scientific work there remains a sense of loss greater even from the personal than the scientific point of view.

His winning personality and idealistic temperament, his vitality, boundless nervous energy and infinite kindness, never permitting him to spare himself when he could help others, his boyish simplicity, and his lofty sense of loyalty and morality made him a colleague who inspired the warmest degree of affection and have secured for him a permanent place in the hearts of all with whom he came into close contact. B. T. P. BARKER.

Mr. Guy Neville, formerly a young gardener at Kew, who was interned at Ruhleben, has furnished us with the following account of the work done by Dr. Lechmere at the camp:—

Dr. Lechmere had a cheerful and happy disposition that endeared him to all, but only those who knew him intimately could appreciate at its true worth his utterly unselfish, chivalrous, and upright nature; he was a true and thorough gentleman in the very best sense of the term, one whom it was a privilege and pleasure to know and whose loss will leave a feeling of personal bereavement in the hearts of his friends.

At the outbreak of war Dr. Lechmere was in Munich studying various methods in Cytology prior to taking up his appointment as Mycologist at Long Ashton Research Station, and was sent to Ruhleben on the 6th November, 1914.

Life in the camp in the autumn and winter of 1914-15 was very severe and depressing, the food consisting chiefly of black bread and soup, while the sleeping accommodation was very bad and insufficient, but despite all privations, Dr. Lechmere kept cheerful, and, seizing the first opportunity, started in the summer of 1915 a series of lectures in Invertebrate Zoology which, with various intermissions, continued until the break-up of the camp in November, 1918.

These first lectures, on the *Hydrozoa*, were held in the open grand stand and speedily attracted a small but devoted band of enthusiasts. The lectures were, however, discontinued owing to cold weather, but restarted in the spring of 1916, when a barrack loft was equipped (?) as a camp school, and two rooms reserved for a Biology Department, one serving as a lecture room, the other as a laboratory for practical botany. A year later these were increased by the addition of a microtomy room and a room which served to house our scientific books. Here a small number of budding zoologists with Dr. Lechmere as their doyen worked together for three years in the most perfect harmony and co-operation.

Dr. Lechmere in these three years lectured continuously, chiefly on the Invertebrata, in which he was very interested. Every phylum, with the exception of the Insecta, was dealt with very exhaustively and thoroughly, and as he was an excellent and interesting lecturer they were always attended with great pleasure. He started a series of lectures in Medical Zoology for aspiring medical and zoological students, lecturing successively on the *Protozoa*, the *Hydrozoa*, *Coelenterata*, *Protochordata*, *Scyllium*, and other types required in the usual medical course. Weekly lectures in Embryology formed a part of this

remarkable curriculum which, I believe, is unique in the annals of prisoners of war.

Popular lectures held in the theatre on such subjects as venereal diseases, evolution, microbes, monkeys, etc., made him well known to the camp, for great numbers flocked to see his marvellously arranged shadow pictures, the monkeys especially causing general astonishment and wonderment. He spent the major part of his time working in the laboratory where, being an excellent electrician, he superintended the electrical arrangements such as seed testing apparatus, incubators, imbedding bath for microtomy, electric control clock, etc. A transformer to reduce the 220 volt circuit to 4 volts for microscopic illumination he made out of old wire and flex.

These activities are related to show how he occupied his time, but only those working with him under such surroundings can adequately appreciate his constant all-pervading help and companionship which made our life livable in the dull monotony and routine of camp life and which earned our permanent gratitude. This utter unselfishness was the most inviting side of his character, for he completely forgot himself in his desire to aid, materially and morally, anyone who appealed to him for advice or assistance. though this trait was not allied to any weak sentimentality, but the spontaneous expression of a most tender and generous disposition.

Dr. Lechmere had numerous friends in other camp activities, for he, at one time, actively assisted the theatre in designing and making dresses, and was often called upon for advice, for he had a very artistic temperament.

The 23rd November, 1918, saw the first happy batch of prisoners leave Ruhleben for England, Dr. Lechmere accompanying them in the service of the Red Cross, for he assisted to transport several stretcher patients. These safely landed in England left him at liberty to enjoy a much needed holiday.

The next time I saw him was at Long Ashton, where he was establishing a home for himself; little did we think that in such a short time he would be no more. Science has lost a gifted and valuable servant. His friends have lost much more—a very brave and valiant heart. G. N.

Ranunculus nissanus.—In the note on this species in *K.B.*, 1918, pp. 374-5, the following typographical errors occur:—on p. 374, line 37, *nyssanus*! should read *myssanus*!; on p. 375, line 4, for par. read pars.; line 23, for longiusculum read longiusculam.

Scheffiera siamensis.—In the description of this plant in *K.B.*, 1918, p. 363, the type is cited as *Kerr* 2281. This should read *Kerr* 2881.

FIG. 1.

FIG. 2.

To face page 169.]

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 4] [1919

VII.—NEW ZEALAND FLAX.

(*Phormium tenax*).

(With Plates).

Introductory.

The possibility of growing New Zealand Flax (*Phormium tenax*, L.f.) as a commercial undertaking in the British Isles has for some years been a matter of interest and experiment with certain landed proprietors in Scotland and Ireland. The matter has also been of considerable interest to Kew since its successful introduction to the Royal Gardens through the enterprise of Sir Joseph Banks in 1789.

An account of the early distribution of the plant from Kew is given in the Botanical Magazine, vol. 59, 1832, plate 3199, and by that time it had proved its suitability for cultivation both in Inverness-shire and at Salcombe in Devonshire, and Sir William Hooker pointed out that "the South of Ireland would in all probability be found to be well suited to its growth and increase."

Sir Joseph Banks, too, in Cook's first voyage, quoted in the Botanical Magazine, says of New Zealand flax that it "would certainly be a great acquisition to England, where it would probably thrive with very little trouble, as it seems to be hardy, and to affect no particular soil; being found equally in hill and valley, in the driest mould and the deepest bogs. The bog, however, it seems rather to prefer, as near such places we found it to be larger than elsewhere."

Since these early efforts to spread a knowledge of New Zealand Flax and its value as a commercial possibility, several more recent attempts have been made to assist in the development of an industry by advice and with the supply of plants for cultivation.

That *Phormium tenax* is amenable to cultivation in the open in the British Isles has long been known, but whether it can be regarded as proved that its cultivation is likely to be a commercial success is still held to be doubtful. One reason which accounts for the doubt as to the suitability of *Phormium* for

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extensive cultivation is that the variety with drooping leaves, usually grown in gardens, is not the form which gives the best yield of fibre. The other and more weighty reason is that attempts have been made to grow New Zealand Flax in places for which it is not suited. In such places it may grow, but the growth is so slow that, as a commercial undertaking, there could be no possibility of success.

In order to overcome the first difficulty the Director of Kew approached the High Commissioner for New Zealand some years ago with the request that plants of the best fibre-yielding varieties of *Phormium* might be sent over from New Zealand for experimental cultivation in the British Isles.

The first consignment of plants from New Zealand reached Kew in September, 1914, and consisted of eighteen named varieties, and the following list of their names was supplied by the High Commissioner:—

Awanga	Putaiore
Pare Tarewha	Ngatanui
Arero Whara Whara	Pare Kori
Tutaemanu	Tamatea
Parakawariki	Tupari
Mukama	Hutero
Oene	Rautamoa
Katirawkawa	Matukaroimata
Tihore	Kopupungawa.

Sets of these plants were distributed to the Scottish Board of Agriculture, the Irish Department of Agriculture, the Marquess of Lansdowne, Derreen, Co. Kerry, and to the late Mr. T. A. Dorrien-Smith, Tresco, Isles of Scilly. The four plants which survived at Kew were sent for trial to the Magnetic Observatory, Eskdalemuir, Langholm, Dumfriesshire.

We learn from Major A. A. Dorrien-Smith that two of the varieties are growing well at Tresco Abbey. One is a strong-growing, long-leaved form with leaves some 8 ft. long, curved over at the top, glaucous in colour with a brown mid-rib, the other is a dwarf form of spreading habit with erect pale green leaves. The names have unfortunately been lost. The plants sent to Eskdalemuir succumbed to the severe frost in the winter of 1915, so that the higher moorland of Scotland does not appear to be suitable to the growth of New Zealand Flax.

Thanks to the kind offices of the High Commissioner a further consignment of *Phormium tenax* was received at Kew from New Zealand in July, 1915, but of these only six arrived in a living condition and at the present time there is only one survivor, the others having succumbed to the cold of the winter at Kew.

In December, 1918, another consignment of seventeen named varieties was sent over from New Zealand at the request of the High Commissioner and arrived in very good condition.

In order to test the suitability of these plants for British conditions they have all been sent to the Rt. Hon. Lord Ventry, at Burnham, Dingle, Co. Kerry, for trial under conditions most likely to be favourable to their growth and the experiment will be watched with interest.

The consignment consisted of the following varieties:—

Koroekihi	Tamatea
Oue	Ngutunui
Awanga	Tutaemanu
Whahariki	Raukama
Aerowharawhara	Tihore
Huhiroa	Putaiore (from Taranaki)
Ate	Katiraukaroa
	Hill Variety.

Pare-Kori-tawa } Both types of variegated
Pare-Kori-tawa } are known by the same name.

With regard to the localities in the United Kingdom where New Zealand Flax may be expected to be a success, Cornwall and parts of Devon in England, the W. of Scotland and the S., S.W. and N.W. of Ireland may be mentioned as the most likely places.

In S.W. Scotland the plant has been cultivated on an extensive scale by Mr. J. Wallace, Loch Ryan House, Stranraer, with very promising results and by Mr. J. A. Campbell, Arduaine, Argyllshire. In Ireland extensive plantings have been made in Co. Kerry, which have proved that a New Zealand Flax industry in that county, and possibly also in Co. Cork, has every prospect of success.

Experiments have been tried in other parts of Ireland, under the auspices of the Irish Department of Agriculture, in Wicklow in particular, with the object of testing the possibility of setting up a profitable industry in Ireland. The results have been disappointing. This is hardly a matter of surprise since the places chosen for the experiment were quite unsuitable; it is, however, somewhat unfortunate, since considerable weight has been attached to the failure of these experiments and the adverse results have been held to prove that there is no chance of establishing a profitable industry in the country.

Since, however, in the course of the enquiries instituted by Kew, we have learnt that *Phormium* can be grown with success in S.W. Ireland and in the W. of Scotland, it seems desirable to place the matter on record, and to this end an invitation was sent to the Rt. Hon. Lord Ventry, Burnham, Dingle, Co. Kerry, asking him to contribute an account of his experiments with New Zealand flax for publication in the *Kew Bulletin*. With this request Lord Ventry very kindly acquiesced and has sent the following account of his work in Co. Kerry with several photographs, some of which are reproduced in this article, showing the rapid growth which the plants have made.

Lord Ventry has been growing the 'Powerscourt' and five other varieties of New Zealand Flax, and it may be that one of the varieties recently received from New Zealand and sent to him for trial will yield even better results than he has already obtained. Whether this be so or not, the evidence goes far to show that the possibility of growing *Phormium tenax* in S.W. Ireland as a commercial undertaking is an established fact.

Lord Ventry's account is of value more particularly because he has dealt with the cultivation of the plant and given full details as to the system he has adopted, the nature of the soil most suitable for its growth, the yield of fibre and the time taken to produce a crop.

With regard to the future commercial value we are not directly concerned, but it seems clear that if the fibre grown in this country can be used for such purposes as that imported from New Zealand, its success as an industry should be assured.

Before giving Lord Ventry's account of his experiments, the experiences of Mr. Wallace in the S.W. of Scotland, and of country can be used for such purposes as that imported from New Zealand flax, are recorded.

Mr. Wallace, of Loch Ryan House, Stranraer, has furnished the Director with the following particulars as to his experience with New Zealand flax:—

"The plant is easy to grow and it will grow in almost any soil and will stand up to 20° of frost. There are many varieties of the plant, but only comparatively few of them are suitable for cultivation in this country as a fibre plant. While it will grow in almost any soil, it undoubtedly does best where there is moisture present, even in absolutely swampy places.

"The plant takes a long time to come to maturity from seed or even from division of old plants, both of which methods of propagation succeed quite well. I find home-grown seed does better than imported seed from New Zealand.

"I find it means locking up land from 8-10 years before a first cutting can be got, so would not be inclined to plant arable land with it. Swampy, wet land and rough hillsides, where bracken grows strong, suit it well and such places might very profitably be planted with it. I had a few tons of fibre extracted by an experimental machine the year before the war commenced and got an excellent report on the fibre from the ropemakers some of it was sent to to be made into binder twine.

"It produces seed freely in this country and the plants are easily raised. My experiments have all been made near the sea.

"After reaching maturity a certain number of leaves may be cut every year or the plant may be cut over entirely every third or fourth year. Both methods, I believe, are practised in New Zealand.

"I incline to think that cutting the outside leaves of each crown every year is the more satisfactory method and gives a more regular fibre both as regards length and strength. The main objection to annual cutting is that it entails more labour.

"As to its uses, it is, of course, a very strong and long fibre, and it is in great demand for the making of binder twine. I understand the Navy do not favour the use of ropes made of it as it does not take tar well but has to be oiled if used in water. The Maoris make a fine cloth of it and I believe the Japanese use a fine quality of it to adulterate silk.

"It could be used for almost anything that a strong fibre is wanted for.

"The fresh leaf can be used, torn into strips, for garden tying."

Mr. J. Arthur Campbell, of Arduaine, Argyllshire, writes as follows as to his experiments in cultivating New Zealand flax:—

"Some years ago, when there was a good deal of talk about bringing in a 'Small Holders Bill,' knowing how difficult it was for people with a small holding to make a living off our West of Scotland land, I suggested to the Congested Districts Board that as *Phormium tenax* grew well in my garden here in peaty soil, and as New Zealand was at that time exporting fibre to the value of a million sterling, it was worth their while experimenting with its cultivation and endeavouring to get the industry started in this country in the congested districts.

"As nothing appeared to come of it I decided to experiment with it myself.

"I procured seed from New Zealand but as it failed to germinate I decided to try home-grown seed. This was kindly supplied by Lady Ilene Campbell, of Stonefield, Argyllshire. Some of this I sowed in the open ground in my nursery and some in boxes in my greenhouse.

"The latter came up well and some 500 or 600 plants were pricked out in the open in the spring. The seed sown in the open failed to germinate. Owing to the war and the shortage of labour, the plants are still in my nursery.

"What I have so far learnt is this:—

"1. The most successful way of raising plants from seed is to sow in boxes in a cool or heated greenhouse.

"2. The plant grows luxuriantly in cultivated peat soil.

"3. New Zealand friends tell me that with them the plant grows on both dry ground and in swamps and that it grows more luxuriantly in the swamps.

"My experience is that it grows best in a well drained and cultivated peat soil. I have planted some in a wet peat and they are growing, but much more slowly than those on a drained though moist soil. It may be that the ground is *too* wet for the young plants, but as they get older and larger they will dry the ground to a certain extent and may then possibly beat those on the drier land.

"4. From my limited experience I should say that if planting roots, split off a large clump with leaves 4 ft. to 6 ft. long, it is advisable to cut off the old leaves about a foot or 15 in. from the ground before planting, taking care not to injure the top of the new young leaf which will be coming between them.

"5. I have two species under cultivation, the ordinary *Phormium tenax*—the Powerscourt variety—of this I have three kinds; and *Phormium tenax Colensoi*. The latter is very much shorter in the leaf and is probably not worth cultivating from an economic point of view.

"One of my varieties of the ordinary New Zealand flax I obtained from Mr. Osgood Mackenzie, of Inverewe, Poolewe, Ross-shire, and was grown from seed sent him by an old shepherd who went to New Zealand. It is very like the Powerscourt one and may be the same, but at Inverewe it produced leaves 8 ft. long, and none of my others are more than 6 ft.

"I have had no experience as to the proper distance apart to plant for economic purposes, but from the way the plant

grows with me I should say that it should not be planted any closer than 8 ft. between the lines and 6 ft. in the lines. This point can only be settled satisfactorily by actual trial, and no doubt different districts will require different distances.

"If *Phormium tenax* is being grown commercially it would be advisable to plant in sheltered places or to have quick-growing hedges for shelter—as otherwise the ends of the taller leaves get frayed with the winter gales. To pick these leaves out of the bulk would cost labour, and if they were not picked out their darkened ends would deteriorate the quality of the bulk and so reduce price."

It seems likely that as *Phormium tenax* is amenable to cultivation in Wigtownshire and Argyllshire it would prove successful in selected spots in the Hebrides, where conditions would appear to be favourable for its growth.

In confirmation of the statements made by Lord Ventry in his account of the experiments he has made in Co. Kerry, the following report on Lord Ventry's plantations by the Irish Department of Agriculture is of value. This report was sent to Kew by the Board of Agriculture and Fisheries and is included here with their permission:—

"In no part of Ireland where New Zealand flax (*Phormium tenax*) has been tried does it appear to have made satisfactory growth, except on the estate of Lord Ventry at Burnham, Dingle. Sir Frederick Moore visited these plantations on 27-10-1915 and reported that, although the plants were grown under varying conditions as regards soil, aspect, etc., the growth was in all cases excellent, luxuriant and vigorous. The climate of the district, however, appeared to be exceptionally mild, and further, the soil was on the whole capable, when well treated, of growing good farm crops. Good crops of sound, clean potatoes had been lifted from land adjoining."

New Zealand Flax in Co. Kerry.

The Rt. Hon. Lord Ventry's Report.

It has long been apparent that New Zealand Flax (*Phormium tenax*) grows very vigorously in the extreme S.W. of Ireland.

In May, 1914, I divided a number of old plants which had been growing here for many years and planted them in an old neglected grass field, after ploughing and harrowing. I know now that this was too late to plant them out, the middle of March would have been much better. There was no rain to speak of until the end of June, but as soon as it came the plants started into growth. They are now (February, 1919) from 6½ to 8 ft. high, and are killing the heavy growth of coarse grass which until now has checked their full development. I expect them, if not cut, to be up to 9 ft. high by November, and to yield then at least 40 tons of leaves to the acre, though I have not yet had sufficient experience to enable me to make a very confident estimate.

In the autumn of 1914 I was given seed from New Zealand by a friend which failed to germinate owing, I think, to its being too old, but some fresh seed of my own grew very well, and I planted about five acres with these seedlings in the spring of 1918. These now

FIG. 3.

FIG. 4.

FIG. 5.

[*To face page* 174.

FIG. 6.

FIG. 7.

FIG. 8.

To face page 175.]

average about 3 ft. high, with several "fans." A considerable number are 4 to 5 ft. high, with up to 12 "fans."

I can find no record of growth in New Zealand to beat this, and I think that, if cut at 5½ years from the date of sowing, they would yield a crop of several tons to the acre. Since 1914 I have grown seedlings every year and bought plants as well. I have lost a good many by planting them out too small and, for want of labour, not keeping them clean enough for the first year or two; but I have now (February, 1919) about 31 acres planted out and doing well. I have also strong seedlings enough for 15–20 acres more, which should be fit to plant out next autumn, and smaller seedlings for about a further 15 acres. Five-sixths of my plants are of the variety known in Ireland as "The Powerscourt Variety."

This (No. 1) is, in my opinion, the same as that grown by Mr. Wallace of Loch Ryan, near Stranraer.

I see it growing better inland than any other variety and believe it to be the hardiest. The leaves are very erect, the undersides of a light bluish-green and the edges and keel with a narrow black or dark red border.

It grows here up to 9 ft. high, with flower-stem 10–12 ft. high, and I think it is the variety called "Huhiroa" by the natives of New Zealand.

(2.) I have a small stock of another variety with a darker green leaf and a broader black edge. It promises well.

(3.) I have a few thousand of what I believe to be the "hill flax," native name "Tihore," of New Zealand. It does well here, but I never see a good plant of it inland. It does not often grow more than 6 ft. high, with flower stems 7–8 ft. high. The leaves are very erect and numerous and it has a general yellowish-green effect. It is said to make a very good fibre.

(4.) A small stock of a bronze or copper-coloured variety with a red or black edge and keel to the leaves. It will, I think, reach 9 or 10 ft. high here, and appears likely to make good fibre.

(5.) Two or three variegated varieties. Some of these are said to make good fibre in New Zealand. They do well here, but I have not seen them growing well inland.

(6.) The old common variety with drooping leaves, which has been grown in Co. Cork and Co. Kerry certainly for 50 years. It is probably the common "Swamp Flax" of New Zealand. It will not do inland, but here it yields a heavy crop. It grows well on poor wet soil and in exposed situations. The fibre, I think, is not of the best, but still it is of value.

I cut 16 tons of leaves of this variety in May, 1917, for the Irish Paper Mills Company, of Clondalkin, near Dublin. It was made into brown wrapping-paper and was very well reported on by Mr. J. Strachan, expert chemist to the Company. Mr. F. Becker, chairman of the company, fully concurred in this opinion. Mr. Strachan also considered that the flax leaves are well fitted for making special lines of high-class paper, such as banknotes, untearable labels, etc., the only obstacle being the present high price of the fibre.

At present, however, the main purpose for which this fibre is used is for making binder-twine and high grade string and cord. For these it is as good, if not better, than any other fibre. Fibre

suitable for binder-twine is at present imported from Manilla, Mexico, East Africa and New Zealand. The demand for it is rapidly increasing and is supplied with difficulty.

It may be said to be *the* key commodity, as without it the world's harvests cannot be reaped. It is estimated that 20,000 tons per annum are consumed in the United Kingdom alone.

It is difficult as yet to estimate the yield of fibre per acre in this country, but I am confident that, if fairly treated, it will be over 1 ton per acre per year and I hope for 2 tons. The yield in New Zealand varies greatly. Once established the plant yields crops for many years, nobody knows how many.

In 1914 I had about 60 lbs. of fibre made from my leaves and had it valued by Mr. F. Agar, director of Hindley & Co., Fibre Brokers, and by the Belfast Rope Works Company, who both handle large quantities of New Zealand fibre. They practically agreed in valuing it at just below the New Zealand Government grade "Good-fair." This is a good grade, worth then about £27 per ton, and just before the war, in July, 1914, £32 per ton. I may add that I can find no record of healthy well-grown leaves failing to produce good marketable fibre. I am much indebted to Mr. Agar for information and help in my undertaking.

Owing to the weight of the leaves they should be milled within a few miles of where they are grown. The cost of a mill I expect to be between £1000 and £2000, and a few acres of drying ground would be needed for each mill. To promote the growth of the crop on a considerable scale it would be necessary to raise a stock of plants for sale at reasonable rates. This would take time and care and might very properly, I think, be undertaken by, or assisted by Government.

Experimental plantings should be made on boggy and poor moorland soil. The growth of those plants I have in such situations is encouraging.

I have not been able to devote as much labour to its cultivation as I should have liked, and I feel confident that improved treatment would very much increase the rate of growth, especially of young plants.

Given a supply of strong young plants, I am convinced that the plant can be profitably grown by the farmers on the S.W. coast of Ireland.

It is impossible for the weather to be too wet for it and it has two great advantages over other crops; in the first place it can be harvested at any time of the year, and secondly, the work can be done in any sort of weather. Provided the crop is properly fenced and strong healthy stock is planted and kept free from heavy grass just round each plant for the first year, the growth of an acre or two would I think present no difficulties to the small farmer.

VENTRY.

EXPLANATION OF PLATES I, II AND III.

Fig. 1.—Plants of the "Powerscourt" variety of *Phormium tenax* bearing seed. The photograph was taken at Burnham, Dingle, in October, 1917. The plants are now (March, 1919) about 8 ft. high.

Fig. 2.—Divided plants of *Phormium*, 3 years and 1 month from the date of planting. A photograph taken 14 months later shows the same man nearly hidden by the plants.

,, 3.—Seedlings growing between the 6 ft. rows of older plants at Dingle, Co. Kerry. The seedlings will be lifted when strong enough to plant out.

,, 4.—Seedlings in the garden at Burnham, Dingle, 1½ and 2 years old.

,, 5.—Two-year old seedlings in the garden.

,, 6.—Seedlings from seed ripened at Burnham, sown in November, 1914. The average height in February, 1919, was 3 ft. with several "fans." A considerable number of plants were 4 ft. 6 in. high, with up to 15 "fans."

,, 7.—A clump which was cut down at the end of October, 1915. The photograph shows the condition of the clump in September, 1918.

,, 8.—An old plant of about 13 years' growth.

VIII.—SPECIES PLACED BY SACCARDO IN THE GENUS PHOMA.

W. B. Grove.

The following notes on some of the foreign species placed by Saccardo in *Phoma* are the result of an examination of the specimens preserved under his names in the Kew Herbarium. Many of them belong to those received by Berkeley or Cooke from the United States during the last century, concerning which nothing has been published since their receipt and first description; upon them modern knowledge throws now a clearer light.

This investigation is a continuation of that begun three years ago, which found expression in the *Kew Bulletin*, 1917 (p. 49), under the title "The British Species of *Phomopsis*." For this reason the species which belong to *Phomopsis* are placed first, followed by those which prove to belong to other genera. There are still many other species which have not yet been examined.

With regard to *Phomopsis* it may be mentioned here that the present list adds one more to the British species, and that the following names must be appended to those given in *Kew Bulletin*, 1917, p. 50, of the species in which both A and B spores have been observed (five of these have been already recorded in the Journal of Botany, 1918, p. 292):—

P. ampelina
P. Asparagi
P. corticis
P. delitescens
P. Eres
P. oncostoma
P. padina
P. Pittospori
P. Pseudacaciae
P. pustulata
P. quercella
P. Stewartii
P. subordinaria
P. venenosa
P. viticola, var. *ampelopsidis*.

In further reference to the article in the *Kew Bulletin*, it is now clear that, as was suspected at the time, *Phoma Rosae*, Schulz. & Sacc. (p. 63) is the same species as *Phomopsis incarcerata*, p. 57; for specimens recently collected at Hereford show the latter occurring indifferently on the stems and on the prickles, with nearly the same character on both.

One feature which becomes clearer at every stage of this enquiry cannot but be regarded with satisfaction—that is, the gradual disappearance of many "species" of *Macrophoma*. This genus was founded merely upon the length of the spores (15 μ or more), and its formation by Berlese and Voglino, together with the similar cases afterwards concocted by the artless genius of Allescher, reminds one of the simpler arithmetical exercitations current in the lower classes of a kindergarten school. All that was required for such a feat was the ability to count up to fifteen and to write, or print, the word "Macrophoma." Of course, if the size of the spore is indicative of and associated with other more profound differences of structure, it may become useful as a guide, and some species of *Macrophoma* will be firmly established upon that basis. But this is not the principle that was present in the minds of the authors. Most species assigned by them to *Macrophoma* will be found to be either errors of fact or young states of *Sphaeropsis*, *Diplodia*, etc. The compilation of this genus in 1886, so far as it took place from mere book knowledge, is a perfect instance of how not to do it. Such a procedure serves little purpose in any case, and least of all in the Fungi Imperfecti, which are destined in the distant future to disappear more or less completely from our lists.

The numbers prefixed to the species mentioned in the following pages are those of Saccardo's Sylloge, vol. iii. All the figures are magnified 600 times except where it is otherwise stated.

SPECIES TO BE TRANSFERRED TO PHOMOPSIS.

399. Phoma oncostoma, *Thüm.*

Phomopsis oncostoma, *v. Höhn.* in Sitz. Akad. Wiss. Wien., 1906, cxv. 33. Trav. Flor. Ital. Crypt. Fung. p. 197. Died. Krypt. Mark Brand. ix. 267. Sydow, Mycoth. Germ. no. 1014!

Cytospora orthospora, Berk. & Curt. North Amer. Fung. no. 458 (exsicc. Pennsylv. Michener, no. 5158! New Jersey, no. 4681!). Sacc., Syll. iii. 272.

C. Robiniae, Schwein. p.p. (exsicc. Herb. Schwein.! and Pennsylv. Michener, no. 5132!).

Pycnidia gregarious or arranged in rows, pustular, covered, raising the epidermis considerably and at length bursting it by the broad obtuse dark-grey discoid apex, blackish, up to 500 μ diam.; texture thick, dark olivaceous. Spores fusoid or elliptic-fusoid, acute at both ends, mostly biguttulate, 8-10 × 2-2·5 μ; sporophores subulate, about twice as long.

On twigs and branches of *Robinia Pseudacacia*. Brit. Fr. Belg. Ital. Germ. U.S.A. The pycnidium of *Diaporthe oncostoma*, Fckl. = *Chorostate oncostoma*, Trav.

The pycnidia of this species approach those of a *Cytospora*. They are not only lobed within and pseudolocellate, but are often clustered several together in one pustule with the ostioles emergent in a common disc. In fact, it stands in the same relation to a typical *Phomopsis* as *Chorostate* does to the other sections of *Diaporthe*. There is, moreover, an apparent stroma, which is sometimes greenish, but this seems to be part of the altered cortex, for the green tinge is due to plastids. The pycnidia are deeply seated, and in growing to the surface push up a large quantity of the cortex before them.

All the specimens in the Herbarium under the synonyms given above belong to the same species: they all have the same spores and sporophores, and differ merely in age. In the specimen of *Cytospora Robiniae*, ex herb. Schweinitz, which is old and exolete, the fusoid spores are very few, but they are accompanied by a few filiform hooked bodies exactly like *Phomopsis* B-spores, measuring about 18-20 × 1 μ. These were seen and sketched by Berkeley. There are also specimens of some of the other species of *Cytospora* upon *Robinia*: of these *C. parva*, Berk. & Curt. (no. 3424!) is smaller and otherwise different, having broader and more "tip cat"-like spores, approaching those of *Phomopsis stictica*, Trav., and *C. coccinea*, Fr., is quite different.

It is very possible that this *C. parva* is equal to *Phoma abnormis*, Sacc., and both are equivalent to *Phomopsis Pseudacaciae*, *Trav.*, which has "tip-cat"-like spores. The latter species, which belongs to *Diaporthe fasciculata*, Nits., of the section *Euporthe*, is smaller than *P. oncostoma*, and is found on petioles as well as on twigs.

The conclusion is that there are two species of *Phomopsis* occurring on *Robinia*—branches, twigs, and petioles in the one case, branches and twigs in the other—the one tending to be unilocular, and belonging to *D. fasciculata*, the other to be plurilocular and belonging to *D. oncostoma*. This confirms the result arrived at by the study of the species in the former paper, viz., that the pycnidia of true *Diaporthe*, Trav. belong to typical *Phomopsis*, while those belonging to *Chorostate*, Trav. tend rather to resemble, more or less, *Fusicoccum* or *Cytospora*. Further examples of the latter case are seen in *Phomopsis quercina* and *P. fibrosa*, belonging respectively to *D. (Chorostate) leiphaemia* and *D. (Chorostate) fibrosa*. The former of these has various forms of pycnidia and spores, ranging from true *Phomopsis* to true *Fusicoccum*. This result might be made a fair ground for argument in favour of the generic separation of *Chorostate*, as adopted by Traverso. *Vide infra*, no. 433.

423. Phoma melaleuca, *Berk. & Curt.*

This is represented in Herb. Berk. by three specimens, all from U.S.A. and labelled in Berkeley's handwriting: Berkeley's only reason for lumping them together was that he recognised in them a common character which we know now to be that distinctive of *Phomopsis*.

These three are—(1) *Phomopsis viridarii*, Grove, in *Kew Bull.* 1917. no. 4096, on twigs of *Magnolia tripetala*, p. 67: (2) no.

5274, on branches of *Berberis*, is *Phomopsis berberina*, Grove (see below); and (3) no. 5185, on petioles of *Aralia spinosa*, is the one for which Berkeley's specific name *melaleuca* should be retained, as this species appears not to have been met with elsewhere.

PHOMOPSIS BERBERINA, *Grove.*

Phoma berberina, Sacc. & Roum. in Rev. Mycol. 1880, p. 191. Sacc. Syll. iii. 72.

Pycnidia scattered or loosely gregarious, without any stroma, subepidermal, globose-depressed, brownish-black, about 300 μ diam. Spores fusoid, acute at both ends, biguttulate, 7-8 × 2 μ; sporophores at first ampulliform, tapering sharply upwards (*i.e.*, strongly obclavate), 9-12 × 3 μ wide at the base, afterwards more elongate, subulate, 12-14 × 1·5-2 μ, rising from a thick olivaceous stratum. (Fig. 1).

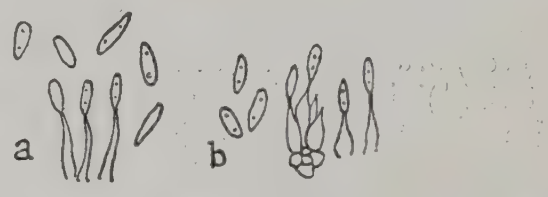


Fig. 1. *Phomopsis berberina*; *a*, from Roum. no. 1015; *b*, from Berk. no. 5274.

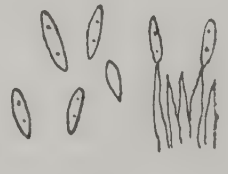
On branches of *Berberis*, Tarbes, France (Roum. no. 1015!); New England, Sprague (Herb. Berk. no. 5274!).

Certainly different from *Phomopsis detrusa*, Trav. Pycnidia very imperfect. All the English specimens which I have seen under the name *Phoma berberina* were not fully developed, but did not in any case belong to *Phomopsis*.

PHOMOPSIS MELALEUCA, *Grove.*

Phoma melaleuca, Berk. & Curt. in Grevill. 1873, ii. 82. Sacc., Syll. iii. 73, p.p.

Pycnidia scattered, oblong-depressed, 300-400 μ long, imperfect, black, covered by the epidermis and each surrounded by a deep brown stain, piercing the epidermis by the short ostiole. Spores broadly fusoid, acute at both ends, biguttulate, 7-9 × 2·5-3 μ; sporophores subulate, 12-15 × 2 μ. (Fig. 2).



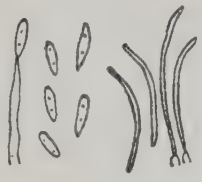
P. melaleuca from Berk. no. 5185.

On petioles (*not* branches) of *Aralia spinosa*, Alabama, Peters (Herb. Berk. no. 5185!). This is not likely to belong to *Diaporthe Araliae*, E. & E., since that is a *Chorostate* (= *C. Araliae*, Trav.).

425. Phoma Pittospori, *Cooke & Hark.*

Phomopsis Pittospori, *Grove.*

Pycnidia gregarious, subglobose, obtuse, black, pierced by a round pore, covered, then disclosed as to the upper third, about 200 μ diam. A-spores, fusoid or lanceolate, acute at the ends, biguttulate, 6-8 × 1·5 μ; sporophores subulate, up to 20 × 1·5 μ: B-spores filiform, curved, hamate, or flexuous, 18-20 × 1 μ; sporophores conical, very short. (Fig. 3).



P. Pittospori.

On twigs of *Pittosporum*, California (Hark. no. 2294!).

The two kinds of spores occurred in the same pycnidium, the B-spores most abundantly. The latter resemble closely the sporophores of the A-spores; *in situ* they can, of course, be distinguished easily, but even when loose the sporophores are recognisable by the subulate base, which often contains vacuoles and tapers distinctly upwards. The pycnidium is not in the slightest degree papillate, but very obtuse, and ultimately the upper part of it is laid bare.

433. Phoma padina, *Sacc.*

Phomopsis padina, *Died. l.c.* ix. 264.

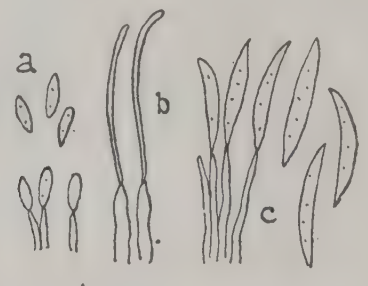
Under the name "*Phoma palina*," there is in the Herbarium a specimen "on dead branches of *Padus*" (Roum. Fung. Gall. sel. no. 493!), which is stated on the label to be *Sphaeria palina*, Fr. Syst. Myc. ii. 494. But there is evidently a confusion here between *S. palina* and *S. padina*, which both occur on the same page of Fries. On examination the specimen turns out to be possibly the same fungus as *Septomyxa padina*, Allesch. in Ber. Bayer. Bot. Gesell. 1892, ii. 6 (Sacc. Syll. xi. 573), though the spores are slightly longer and more acute at the ends than the description states. But in Roumeguère's exsiccatum there are true pycnidia (which do not exist in *Septomyxa*), scattered, subconical, erumpent, at length nearly free. In these were three kinds of spores:—

A-spores, fusoid, 7-9 × 2·5-3 μ, on rod-shaped sporophores as long as or occasionally longer than the spore.

B-spores, filiform, hooked, 25-30 × 0·6-0·7 μ, on rod-shaped sporophores about 15 × 2 μ.

C-spores, fusoid, acute at both ends, curved, at length

faintly 1-septate, granular, 20-22 × 2·5-3 μ, on sporophores which are truly fasciculate, linear or tapering slightly upwards, 20-25 × 1 μ. (Fig. 4).



P. Padina—*a*, A-spores; *b*, B-spores; *c*, C-spores; all from Roum. no. 493.

The A-spores are those of *Phomopsis padina*, Died.; the B-spores are like those found in many species of that genus, but neither of these is what Allescher described. He seems to have met with only the C-spores, but according to Roumeguère's specimen these belong, not to a *Septomyxa*, but to a *Fusicoccum*. They are in shape like those of *Cryptomela atra* (Kunz.) Sacc., as figured by Corda (Sturm, Deutsch. Crypt. Fl. tab. 49), but singly are all but colourless, though faintly pinkish-brown in mass. Although all three kinds of spores were not seen in the same pycnidium, yet A and B spores were found together, and also B and C spores together, so that they all presumably belong to the same fungus, which is *Diaporthe* (*Chorostate*) *decorticans*, Sacc. & Roum., of which *Phomopsis padina*, Died. is considered the pycnidial stage.

It should be noticed that Allescher found what he calls *Myxosporium padinum* in company with the *Septomyxa*, of which it is evidently a mere early state, although he unwisely repudiates any suggestion that they are genetically connected. Possibly the *Fusicoccum* state is merely a variant of the *Septomyxa*, because it is well-known that a *Phomopsis* may be found both with and without a distinct pycnidium, according to its age.

This case is no doubt similar to that of *Diaporthe longirostis*, Sacc., which is also a *Chorostate*, and to which von Höhnel and others assign as pycnidial forms the following "species":—

Phomopsis Tulasnei, v. Höhn.
Septomyxa Negundinis, Allesch.
,, *Tulasnei*, v. Höhn.
Myxosporium Späthianum, Allesch.
,, *Tulasnei*, Sacc., with its variety *monacense*, Allesch., all of which occur on branches, and to which may safely be added:—

Gloeosporium acerinum, Westd.
=*Marssonia acerina*, Bres.

as a leaf-form, differing from the branch-forms merely in being of a less complex construction.

A parallel but simpler case is also met with in *Diaporthe aesculicola* (Cooke) B. & V., which has the following pycnidia:—

Phoma diplodioides, Sacc.
Septomyxa aesculi, Sacc.
Diplodina truncata, Sacc.

All these cases are complicated by the difficulty (in addition to the change of spore-form) that there may or may not be a real pycnidial wall, according to the stage of development that has been reached.

466. Phoma Ampelopsidis, *Sacc.* and 470. Phoma pallens, B. & C.

P. Ampelopsidis, Sacc., was a new combination based on *Sphaeropsis Ampelopsidis*, Cooke & Ell. in Grevill. 1878, vi. 84, pl. 99. f. 8 (= *Macrophoma Ampelopsidis*, Berl. & Vogl. in Sacc. Syll. Addit., p. 306), but the species of Cooke and Ellis does not exist. The spores assigned to it by Cooke (*l.c.*) are the escaped ascospores of the accompanying *Sphaeria* which he mentions. It appears to be a *Physalospora*, but in view of the scantiness of the material present no description can be attempted. The naviculoid spores described and figured by Cooke could be seen both in and out of the asci; they measure 30-32 × 10-11 μ, and are very granular (Fig. 5). There were none on sporophores.

Physalospora sp. from Cooke & Ellis's specimen named *Sphaeropsis Ampelopsidis*.

But on the same twigs of *Ampelopsis quinquefolia* there is a *Phomopsis* which differs from *P. viticola*, Sacc. (in Annal. Mycol. 1915, xiii. 118) in external appearance, especially in the totally undiscoloured epidermis. It may be described as follows:—

Phomopsis viticola, *Sacc.* var. Ampelopsidis, *Grove.*

Pycnidia gregaria, valde imperfecta, subglobosa, 200-300 μ diam., innata, nigrescentia, convexa, vix papillata, epidermidem colore omnino immutatam levant, tandemque irregulariter findunt, at rarius supra eam extant; senio vertex dilabitur. A-sporae copiosissimae elliptico-fusoideae vel sublanceolatae, utrinque acutae, ut plurimum rectae, biguttulatae, 8-9 × 2 μ, sporophoris subulatis, usque 15 μ longis, infra ca. 2 μ latis suffultae: B-sporae filiformes, hamatae vel rarius flexuosae, 20-25 × 1 μ, sporophoris brevibus suffultae.

Hab. in ramulis *Ampelopsidis quinquefoliae* (*Vitis hederaceae*), New Jersey, J. B. Ellis, no. 2704! A very typical *Phomopsis* and agreeing with *P. viticola* except for the total absence of discoloration in the epidermis.

Phoma pallens, Berk. & Curt. (South Carolina, Herb. Berk. no. 5015!) seems to be only a young state of this species, at least so far as the specimens on *Vitis* and *Ampelopsis* are concerned. The form on *Celastrus scandens*, referred to it by Berkeley (Pennsylvania, Michener, Herb. Berk. no. 4127!), though equally a *Phomopsis*, may be different, since it has distinctly larger and often triguttulate spores.

467. Phoma ampelina, *Berk. & Curt.*

Phomopsis ampelina, *Grove.*

Pycnidia gregarious, oblong, black, about 200 μ long, immersed, each pycnidium surrounded by a blackish-brown stain, raising the shining discoloured epidermis and at length splitting it by the minute papillate ostiole which is pierced by a round pore. Spores elliptic-fusoid, scarcely acute at the ends, biguttulate, 8-10 × 2-2·5 μ; sporophores a little longer than the spore.

On twigs of *Vitis*, Pennsylvania, Michener (Herb. Berk. no. 4094!). No spores 12 μ long, such as are described by Berkeley, could be found. The pycnidia are longer than broad, and split the epidermis by a ragged orifice or in a somewhat hysteriiform manner. Allied to *P. viticola*, but different in external appearance.

473. Phoma Edgworthiae, *Sacc.*

Phomopsis Edgworthiae, *Grove.*

On rotting twigs of *Edgworthia chrysantha*, Italy.

A typical *Phomopsis*, except that it is more clustered than usual. Spores 7-8 × 2-2$\frac{1}{2}$ μ; sporophores linear, 20-25 × 1·5 μ. No B-spores, such as are suggested by Saccardo's "basidiis filiformibus, 30 × 1·5 μ" could be discerned.

510. Phoma lirelliformis, *Sacc.* f. ribicola, *Sacc.*

Phomopsis ribicola, Grove.

Pycnidia crowded, imperfect, black, narrow-lanceolate or linear, hysteriiform, up to 1 mm. long but not more than 80-100 μ wide, sometimes confluent in long lines, running parallel and longitudinally on the stem, immersed, then splitting the epidermis in narrow slits. Spores fusoid, narrowed, especially at one end, usually biguttulate, 7-8 × 2·5 μ; sporophores linear, 12-15 × 2 μ.

On twigs of *Ribes sanguineum*, Saintes, France (Rabenh. Fung. Eur. no. 2988!).

The slits in the epidermis are much narrower than in *Phomopsis hysteriola* (Sacc.), and are not placed transversely on the stem as in *P. aucubicola*, Grove, in *Kew Bull.* 1917, p. 67.

On the same sheet is Roum. Fung. Gall. exs. no. 3353! with the label "*Phoma lirelliformis*, f. *Rhamni Alaterni*," from the

same locality, on dry branches of *R. Alaternus*. But this particular exsiccatum showed nothing but *Diplodia clandestina*, D. & M. Fl. Alg. p. 575 (Sacc. Syll. iii. 333) with spores measuring 25-30 × 10 μ.

530. Phoma Diospyri, *Sacc.*

Phoma Diospyri, *Grove.*

Pycnidia gregarious, immersed at the base among the whitish fibres of the wood, then nearly superficial, oblong, hysteriiform, rough, black, up to 400 μ long. Spores fusoid, acute at both ends, sometimes biguttulate, 8-10 × 2 μ; sporophores crowded, subulate, 12-16 × 2 μ, rising from a yellowish proliferous stratum.

On bare wood of large branches of *Diospyros Lotus*, Padua (Sacc. Mycoth. Ven. no. 1209!).

In Sydow, Mycoth. March. nos. 2584! and 2797! on twigs of *Diospyros virginiana*, from Berlin, the pycnidia are immersed in the bark of younger branches, but the spores and sporophores are the same.

544. Phoma imperialis, *Sacc.*

Phomopsis imperialis, *Grove.*

Phoma Paulowniae, Sacc. & Roum. in Mich. ii. 330 (*non* Thüm.)

Pycnidia gregarious, globose-depressed, black, about 300 μ long, covered by the epidermis, which is blackened over and around it and at length pierced by the subpapillate pore. Spores oblong or subfusoid, scarcely acute but usually obtuse at the ends, sometimes biguttulate, 7-8 × 2·5 μ; sporophores subulate, 12-15 × 1·5-2 μ.

On petioles of *Paulownia imperialis*, France (Roum. Fung. Gall. no. 1018!).

This is one of those striking species which (if it be known that the spores are continuous and hvaline) can be assigned to *Phomopsis* at merely a naked-eye view.

560. Phoma Ailanthi, *Sacc.*

Phomopsis Ailanthi, *Trav.*, l.c. n. 196.

Pycnidia gregarious, subglobose, immersed, convex, pustular, black, 330-500 μ diam., long covered by the unchanged epidermis which is at length burst at the summit by a small irregular pore. Spores elliptic-fusoid or sublanceolate, acute at both ends, not often biguttulate, 7-8 × 2-2·5 μ; sporophores subulate, straight, 10-15 × 2-2·5 μ.

On dead branches of *Ailanthus glandulosa*, New Jersey (Ell. & Ev. N. Amer. Fung. no. 2767!). The pycnidium of *Diaporthe* (*Chorostate*) *Ailanthi*, Sacc.

The dimensions of the sporophores, seen *in situ*, are as given; the filiform arcuate "basidia," mentioned by Saccardo (25 × 0·5 μ), must be the B-spores, but none of these were discovered.

566. Phoma Broussonetiae, *Sacc.*

Phomopsis Broussonetiae, *Died.* l.c. ix. 249.

Pycnidia subgregarious or densely scattered, oblong, convex, 250-300 μ diam., thick-walled above, covered by the pallid epidermis which they raise considerably and render paler, then bursting it at the summit, but without projecting above it. Spores fusoid, acute at both ends, biguttulate, 8-9 × 2 μ; sporophores subulate, somewhat curved, 16-20 × 1·5-2 μ.

On twigs and branches of *Broussonetia papyrifera*, France (Roum. Fung. Gall. no. 3071!); Germany (Sydow, Mycoth. March. no. 2583!).

760. Phoma venenosa, *Sacc.*

Phomopsis venenosa, *Grove.*

Phoma mixta, Berk. & Curt. in Grevill. 1873, ii. 82 (f. in *Datura Stramonio*, Pennsylvania, Herb. Berk. no. 4331!).

Phlyctaena arcuata, Berk. in Herb. (f. in *Datura*).

Septoria phlyctaenoides, Berk. & Curt. in Grevill. iii. 10 p.p. (in Herb.)

? *Phoma Daturae*, Roll. & Fautr. in Rev. Mycol. 1893, p. 117. Sacc., Syll. xi. 490.

Phomopsis Daturae, Sacc. in Annal. Mycol. 1915, xiii. 118.

Pycnidia scattered or aggregated, oblong, black, about 250 μ long, depressed, covered, surrounded by a dark brown stain, piercing the epidermis only by the round pore. A-spores shortly fusoid, acute at both ends, often biguttulate, 6-7 × 2 μ; sporophores rod-shaped or subulate, mostly straight, about 10 × 1·5 μ: B-spores filiform, hooked, 20-25 × 0·75-1 μ, on short sporophores.

On stems of *Datura Stramonium*, Pennsylvania, Michener, as above. The two kinds of spores were seen intermingled *in situ* in the same pycnidia. Roumeguère has issued (Toulouse, Fung. Gall. exs. no. 2836!) a *forma Hyoscyami*, on *Hyoscyamus niger*. Both these are accompanied by the incunabula of a *Diaporthe*.

Phoma Daturae, Roll. & Fautr., which is the same as *Phomopsis Daturae*, Sacc., appears to be an ally with rather larger spores (8-12 × 2-2·5 μ), though Fautrey remaks that "il est bien différent," probably because he examined specimens which did not show the beginnings of the *Diaporthe*.

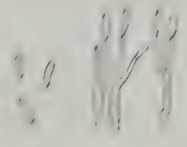
In a similar way to this, the other forms collected under the name *Phoma mixta*, on different hosts, should be assigned to various species of *Diaporthe: e.g.*, that on *Liriodendron* (South Carolina, Curtis, Herb. Berk. no. 4963!) to *D. delitescens*, Bomm. Rouss. & Sacc.; that on *Robinia Pseudacacia* (Pennsylvania, Michener, Herb. Berk. no. 4177!) to *D. fasciculata* Nits., and so on. It is plain, by Berkeley's sketches on his herbarium sheets, that in most, if not all, of these cases he found both the A and the B spores together, whence the name *mixta*, which is applicable, however, to many species of *Phomopsis*. But, if he saw the B-spores alone, he named them *Septoria phlyctaenoides*, thereby placing many specimens under both names in succession.

SPECIES TO BE TRANSFERRED TO DENDROPHOMA.

563. Phoma longipes, *Berk. & Curt.*

Dendrophoma longipes, *Grove.*

Pycnidia densely scattered or subconfluent, immersed, then erumpent, subglobose, obtuse or somewhat papillate, glabrous, black, about 200 μ diam.; texture thick and dark brown. Spores subcylindrical, but rather irregular, 4-5 × 0·75-1 μ, borne at the apex of subulate sporophores which are fasciculate at the base, and occasionally (but not often) branched above, 12-15 × 2 μ. (Fig. 6).



D. longipes, from Berk. no. 2101.

On branches of *Morus rubra*, South Carolina (Herb. Berk. no. 2101!).

This is quite different from *Phomopsis moricola*, and is easily distinguished from *Phoma Mororum*, which has obsolete sporophores. It is closely allied to *Dendrophoma olivaceo-hirta*, Starb., but not identical with it, and has nothing to do with the ascophorous form which was confused under this latter name by Cooke. (This may be, as he says, *Mazzaria olivacea*, Cooke, in Greviil. xvii. 92; it has dark opaque-brown fusoid spores, about 50 × 16 μ. Schweinitz evidently sent out an ascophorous and a pycnidial form, both under the name *Sphaeria olivaceo-hirta*, Schw.).

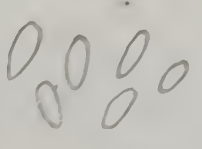
SPECIES TO BE TRANSFERRED TO DOTHIORELLA.

508. Phoma diatrypea, *Sacc.*

Dothiorella diatrypea, *Grove.*

Sphaeropsis diatrypea, Cooke & Ell. in Grevill. 1877, vi. 2, t. 95, f. 6.

Pycnidia subglobose, 300-400 μ diam., rather convex or even papillate above, blackish-brown, immersed 2-8 together in a dingy-brown stroma, which is oblong or lanceolate, longitudinally placed, erumpent and surrounded by the cleft epidermis. Spores very numerous, oblong-ellipsoid or oblong-cylindrical, rounded at the ends, hyaline, 9-11 × 3-4 μ; sporophores not seen. (Fig. 7).



D. diatrypea, from Ellis no. 2532.

On dead branches of *Chionanthus virginica*, J. B. Ellis, New Jersey (Ellis, no. 2532! in Herb. Cooke; Roum. Fung. Gall.

no. 4753!; Thüm. Mycoth. univ. no. 1286!; all forming part of the same collection, Jan. 1878).

On the same branches is *Botryodiplodia Chionanthi*, Grove, which is a true *Botryodiplodia*, having 2-12 pycnidia in each group, but is evidently the same as was issued by Ellis as no. 2531! and named *Diplodia Chionanthi*, C. & E. in Grevill. 1877, vi. 3. In no. 2531 the pycnidia are often single, and only occasionally gregarious, 2-4 together.

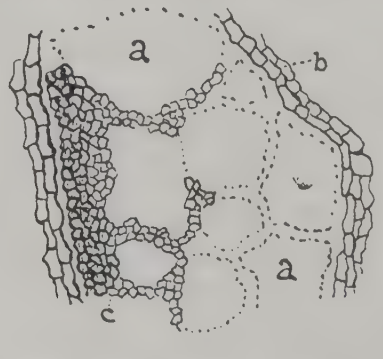
Cooke's figure (l.c.) is very exact, though no spores quite so large as he shows could be discovered. *Dothiorella* is in many cases only at an early stage of *Botryodiplodia*; thus *D. fraxinea* belongs to *B. Fraxini*, and *D. pyrenophora* to *B. pyrenophora*, etc. So here, probably, *Dothiorella diatrypea* belongs to *Botryodiplodia Chionanthi*, and the following species, *D. Crepini*, may belong to *Diplodia mutila*, Fr. & Mont., which shows some signs of being really a *Botryodiplodia*.

574. **Phoma Crepini**, *Speg. & Roum.*

Dothiorella Crepini, *Grove.*

? *Dothiorella populnea*, Thüm. Pilzfl. Sibir. no. 791 (1880). Sacc., Syll. iii. 237.

Pycnidia single or crowded in erumpent botryoid groups of 3-12, girt by the erect laciniae of the burst epidermis, immersed in a common basal stroma, nearly free above, deep inky-black, shining, globose, subpapillate, 100-300 μ diam., pierced by a round apical pore, at length collapsed at apex. Spores very numerous, minute, oblong-cylindrical, straight or curved, *i.e.*, sausage-shaped in profile, obtuse at both ends, faintly biguttulate, 2·5-4 × 1-1·5 μ; sporophores cylindrical, straight, erect, crowded, about twice as long as the spore or even more so. (Fig. 8).



D. Crepini, horizontal section of stroma × 40; *a. a*, bases of pycnidia; *b*, cortex of host; *c*, stroma.

On bark of dead branches of *Populus fastigiata*, near Malmedy (Roum. Fung. sel. Gall. no. 654!). On bark of dry branches of *P. dilatata*, Belgium (Thüm. Mycoth. univ. no. 1681!). On dry branches of *P. tremula*, Germany (Fckl. Fung. Rhen. no. 2566!).

The spores are produced successively from the apex of the sporophores, and sometimes remain for a time in chains. There is often, in a group of pycnidia, one large pycnidium surrounded

by a ring of smaller ones: Fuckel suggests that in this case the central one is a young ascophore, but no evidence in favour of this idea could be found in the specimens examined.

This is said to be the pycnidial stage of *Cenangium populinum*, Fckl., but there seems to be some confusion here. Fuckel issued two fungi as imperfect stages of his *C. populinum*, both on *P. tremula*—no. 2566, which is the present species, and no. 1839! which is different (*see* Symb. Myc. p. 268, and Nachtr. ii. 55).

Phoma Crepini bears much resemblance to certain species of Dermateae; it has a decided basal stroma, and should therefore be placed in *Diothella*. *D. populae*, Sacc. Syll. iii. 237 (Sydow, Mycoth. March. nos. 417! and 1022!) is similar in some respects, apart from the spores, but the pycnidia are fewer, larger, dull brownish-black, and present a very different appearance to the eye. *D. populnea*, Thüm., however, can hardly be anything but *D. Crepini*, though no specimens of it have been seen: if so, the name of the species should be that given by de Thümen.

SPECIES TO BE TRANSFERRED TO CYTOSPORA.

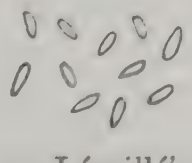
432. Phoma allostoma, *Sacc.*

Sphaeropsis allostoma, Lév. Ann. Sci. Nat. 1846, v. 294.

This is represented in Berkeley's herbarium by a specimen from the Botanic Gardens at Paris, named in Léveillé's own handwriting, on the bark of a large trunk of *Taxus baccata*. It is evidently a *Cytospora*, and appears to be identical with *C. Taxi*, Fckl., differing only in the fact that the pustules measure about 1 mm. across (instead of 2-3 mm.). The spores, however, are hardly "curved," but elliptic-linear and straight, though of about the right size. The fungus described under this name, *P. allostoma*, by Diedicke (Pilz. Mark Brand. p. 178) is obviously something quite different from this specimen of Léveillé, the pycnidia being given as 90-150 μ diam., and the spores being different.

Description of Léveillé's specimen, "*Sphaeropsis allostoma*."

Conceptacles scattered or gregarious, 1-1·5 mm. broad, very convex, covered, then emergent, irregular, black, the broad dingy-black disc pierced with one ostiole (rarely more) and surrounded by the laciniae of the bark; within is a sinuous chamber, surrounding a whitish columella (not always present); contents horny, grey. Spores very numerous, elliptic-linear, straight or in profile faintly curved, 6-8 × 1·5-2 μ, supported on straight, crowded sporophores longer than the spore. (Fig. 9).



Spores from Léveillé's specimen.

The only specimen of *Valsa Taxi*, Fckl., I and II, that I have seen (Fckl. Fung. Rhen. no. 2347!) is very poor, but does not

so far as it goes, disagree with this identification. The fungus on *Ephedra andina* under this name (*P. allostoma*) in Herb. Kew is a *Coniothyrium*, described below:—

CONIOTHYRIUM EPHEDRINUM, *Grove*.

Pcynidia infrequenter sparsa, epidermide tecta, ligno insidentia, oblonga vel globosa, atra, 150-230 μ longa, rima brevi longitudinali depiscentia. Sporulae ovales, copiossissimae, brunneolae, 3-4 × 1 μ.

In ramulis *Ephedrae andinae*, in Horto Botanico Kewensi.

When the bark falls off, the base of the pycnidium is seen to be immersed in the wood; the ostiole is a pore which is more or less compressed to form a slit. The fungus seems to be allied to *C. peradenycum*, Sacc. (Syll. iii. 319).

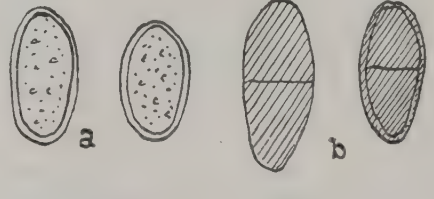
SPECIES TO BE TRANSFERRED TO DIPLODIA.

397. Phoma clavuligera, *Sacc.*

DIPLODIA CLAVULIGERA, *Grove*.

Sphaeropsis clavuligera, Berk. & Curt., Cuban Fungi, no. 562.

"Phoma clavuligera" is nothing but an early stage of a *Diplodia*. Berkeley no. 792 contains young *Sphaeropsis*-like spores. Nos. 791 and 793, which were issued by Berkeley as *Diplodia vulgaris*, Lév., are on the same host, *Dipteryx*, and no. 793 contains older, brown, 1-septate spores. The spores of no. 792 measure 20-25 × 12-15 μ, those of no. 793 22-25 × 10-15 μ, but the two are obviously the same at different stages of growth, exactly as in the next two species. (Fig. 10).



D. clavuligera; *a*, from Berk. no. 792; *b*, from Berk. no. 793.

428. Phoma micromegala, *Sacc.*

DIPLODIA PINASTRI, *Grove* in Journ. Bot. 1916, p. 193.

Sphaeropsis micromegala, Berk. & Curt. in Grevill. 1874, ii. 180. On decorticated roots of *Pinus*, Alabama (Beaumont, Herb. Berk. no. 5090!).

This is undoubtedly *Diplodia Pinastri* compressed by its unusual site. Growing on the bared wood of the root, it seems to attack the cut ends of the rays, and assumes their outline, but in every other respect it agrees with that species. I have met with it besides on bark, leaves and cones of *Pinus*, preserving the same essential characters in each habitat. By observing how it changes as it develops by age, it can be readily shown that *Phoma Pinastri*, Lév. (1846). *Sphaeropsis Pinastri*, Sacc., *S. Ellisii*, Sacc. (1884), *Diplodia conigena*, Desm., and probably also *D. pinea*, Kickx, are all forms of the same species, to which now *Phoma micromegala* must be added. The spores of *D. Pinastri* are known to remain for a long time eseptate and nearly

colourless. Those of the Alabama specimen are not all hyaline, as Berkeley and Curtis assert; many of them have the yellowish-brown colour habitual with young *D. Pinastri* and its typical curved or irregular outline, and I found in the pycnidia at least one spore which was brown and uniseptate.

Phoma macrosperma (Karst.) Sacc., on *Abies excelsa*, is a similar fungus, and presumably also a *Diplodia*; and the same may be said of *P. excelsa*, Karst., but about these (no specimens being available) only suggestions can be made. The old system of putting all such *Sphaeropsidales* in Phoma, without paying any regard to the character of the spores, if only they were continuous and colourless, is now thoroughly discredited; to those who are familiar with the forms even the young spores display many signs which are significant of their future fate.

434. **Phoma persicina**, *Sacc.*

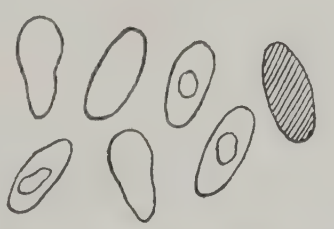
Diplodia persicina, *Grove.*

Sphaeropsis persicina, Berk. & Curt. in Grevill. 1874, iii. 1.

Macrophoma persicina, Berl. & Vogl. in Sacc. Syll. Addit. p. 307.

Diplodia Persicae, Sacc. in Mich. ii. 267 (1881); Syll. iii. 341.

Pycnidia crowded, round, flattened, lens-shaped, then subglobose, 120-250 μ diam., shining, black, covered, then just piercing the epidermis by the short papillate ostiole round which a whitish circle is left; texture rather thick and dark. Spores oblong, straight or faintly curved, obtuse at the ends, not thick-walled—pale-brown, continuous, 1-2-guttulate, 16-18 × 7-9 μ (in Berkeley's specimen)—dark-brown, 1-septate, sometimes gently constricted, 18-20 × 9 μ (in Roumeguère's specimen). (Fig. 11).



D. persicina, from Berk. no. 3422; nearly all the spores were pale brown.

On twigs of *Persica*, Pennsylvania (*Sphaeropsis persicina*, Herb. Berk. no. 3422!); on thin twigs of *Persica vulgaris*, France (Fautrey, Roum. Fung. Gall. sel. no. 5282!); Conegliano, Italy (Sacc.).

These are evidently the same species, the pycnidia as usual being larger on the thicker twigs, and the spores passing through the series of colours and forms characteristic of a *Diplodia*.

455. **Phoma fusigera**, *Sacc.*

Sphaeropsis fusigera, Berk. & Curt. in Grevill. 1874, ii. 181.

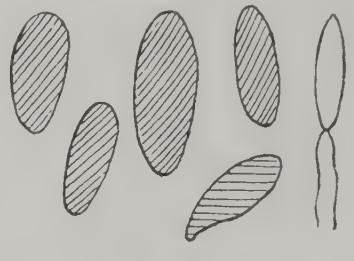
Macrophoma fusigera, Berl. & Vogl. in Sacc. Syll. Addit. p. 312.

This "species" is a mixture of two specimens, which, by inadvertence, Berkeley confused together. Both are, perhaps,

young *Diplodias*, but Berkeley seems to have united the spores of the one with the pycnidia of the other. The one of which he gives the host is probably merely a form of *Diplodia Crataegi*, Westd.

Diplodia Crataegi, *Westd.*, in Kickx, Flor. Fland. i. 393. Sacc. Syll. iii. 340. f. Pyracanthae, *m.*

Pycnidia scattered, erumpent, globose, 400-500 μ diam., black, surrounded above by a reddish meal which arises from the cortex. Spores oblong or obovoid, rounded at the ends, olive-brown, 1-guttulate, not granular, 20-25 × 9-10 μ; sporophores hyaline, straight, 15-16 × 2·5 μ. (Fig. 12).



D. Crataegi, from Berk. no. 4056. The spore on the right is young and colourless, the others are olive-brown.

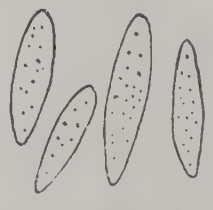
On branches of *Crataegus Pyracantha*, Pennsylvania, Michener (Herb. Berk. no. 4056! marked in Berkeley's handwriting "in Mesp. pyr.," *i.e.*, on *Mespilus Pyracantha* = *Crataegus Pyracantha*; it is not on *Mespilus germanica*). Obviously an immature *Diplodia*.

Berkeley gives a sketch of a spore, showing it to be oblong and about 37·5 μ long. But there can be no doubt that his description in words (*l.c.*) was influenced by the specimen mentioned next, which is different and has much more fusiform spores than even the young spores of this species on *Crataegus*, and for which the name *Phoma fusigera* can provisionally be retained:—

Phoma fusigera, *Sacc.* emend. *Grove.*

Pycnidia oblong, black, about 200 μ long, immersed, then erumpent more or less in lines. Spores not numerous, fusoid, slightly more obtuse above, colourless, granular, eguttulate, 22-28 × 6-7 μ, often slightly inequilateral; sporophores short.

On dead twigs and branches of *Wistaria*, South Carolina (Curtis, in Herb. Berk) (Fig. 13).



P. fusigera, from Curtis's specimens.

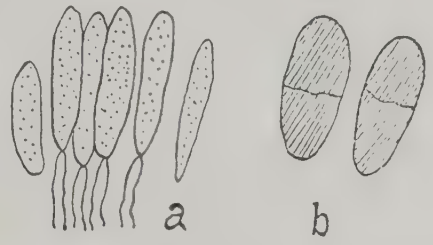
On these specimens there is no trace of red granular matter. It is almost certainly a young *Diplodia* but, although there is little doubt, one cannot assert with perfect confidence that it is an early state of *D. Wistariae*, Brun. (Sacc., Syll. iii. 335), since it is not exactly like the young spores of that species. On one of the older branches of *Wistaria* it is accompanied by an

immature pyrenomycete, showing asci with imperfect spores, which is, no doubt, *Botryosphaeria Wistariae* (Rehm) Sacc. Another specimen (Berk. no. 6250), bearing the same name, on culm of Lily, is nothing but immature *Diplodia herbarum*, Lév.

In the same cover are two other specimens, labelled "*Sphaeropsis fusispora*, C." (? MS. name only).

One of these, on *Rhus*, Poughkeepsie (Gerard, N. Amer. Fung. no. 176!) is immature *Botryodiplodia compressa* (Cooke) Sacc.

The other, on *Ailanthus*, Aiken, South Carolina (Ravenel no. 2136!) is immature *Botryodiplodia Ailanthi* (Cooke) Sacc. (Fig. 14).



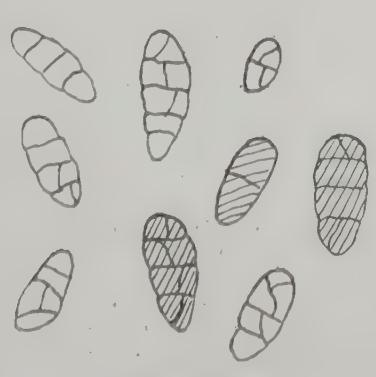
B. Ailanthi, from Roum. no. 2136; *a*, on small branches; *b*, on older branches.

With reference to this latter species, it will be well to take this opportunity of replying to Saccardo's question (Syll. iii. 378) "An diversa a *Botr. scabrosa*?" It is quite different; *B. scabrosa* is large, rugged, and tuberculose, *B. Ailanthi* is in small compact pustules, much like those of *B. compressa*.

In connection with the examination of these specimens it became necessary to investigate *Diplodia Wistariae*, Brun. (in Rev. Mycol. iv. 226). The exsiccatum issued under this name by Roumeguère (Fung. Gall. exs. no. 3372!) yielded that species, but also a *Camarosporium* and a *Microdiplodia*, and on one occasion all three kinds of spores were found apparently in the same pycnidium.

Camarosporium Wistariae, *Grove* sp. n.

Pycnidia solitaria, ca. 300 μ diam., globosa, emergentia, atra, nitida, papillata, pertusa, basi hyphis brunneis cincta, contextu crasso, molli, e cellulis minutis parenchymaticis conflato. Sporulae ovali-oblongae vel subcylindraceae, saepe curvatae, utrinque rotundatae, 1-septate, deinde 3-septate vel rarissime 4-septatae, postremo murali-divisae, vix constrictae, 15-22 × 8-10 μ, achroae, posterius dilute brunneolae, sporophoris brevissimis suffultae. (Fig. 15).

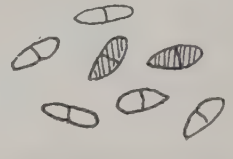


C. Wistariae.

Hab. in ramulis emortuis *Wistariae sinensis*, Bagnères de Luchon. Obviously not a further development of the *Diplodia*, since the sporophores are merely the inner cells of the pycnidial wall, and although the young spores are 1-septate (as usual) yet they are then quite unlike those of the *Diplodia*, being pale and translucent, not fuliginous.

Microdiplodia Wistariae, *Grove* sp. n.

Pycnidia sparsa, usque 250 μ longa, rotundata vel oblonga, tecta, dein rima erumpentia, nigrescentia, contextu molli, minute parenchymatico. Sporulae oblongae vel ovali-fusoideae, altero saltem apice attenuata, dilute brunneolae, 1-septatae, non constrictae, 6-8 × 2·5-3 μ, sporophoris subulatis, spora paullo longioribus suffultae. (Fig. 16).



M. Wistariae.

Hab. in ramulis emortuis *Wistariae*, ibidem.

The texture of the pycnidium is very similar to that of the *Camarosporium*. Exactly the same fungus was found intimately mixed with *Botryosphaeria Wistariae*, Sacc. on a specimen from Aiken, South Carolina (H. W. Ravenel). The probability is that all the species mentioned here on *Wistaria* are stages of that pyrenomycete.

516. Phoma hyalina, *Sacc.*

Sphaeropsis hyalina, Berk. & Curt. in Grevill. 1874, ii. 179.

Macrophoma hyalina, Berk. & Vogl. in Sacc. Syll. Addit. p. 315.

Under the name *Sphaeropsis hyalina* Berkeley issued three specimens, as follows:—

I. On *Fraxinus americana*, Pennsylvania, Michener (Herb. Berk. no. 4201!). This is young *Diplodia inquinans*, Westd. Mature brown 1-septate spores, measuring 25-30 × 10-15 μ, are to be found mixed with the nearly hyaline spores of which Berkeley makes a sketch. The pycnidia stand mostly singly, as they often do in British specimens. But in other specimens every possible stage can be observed on the same branch, between this and *Botryodiplodia Fraxini*, Sacc., and an extensive investigation of numerous examples from many quarters has convinced me that the following are all synonyms of one and the same species, in varying states of growth:—

Botryodiplodia Fraxini, Sacc., Syll. iii. 378.

Diplodia Fraxini, Fr. Sum. Veg. Sc. p. 417.

Botryodiplodia sphaeroides, Sacc., Syll. iii. 379.

Dothiora sphaeroides, Cooke, Handb. p. 429 (*non* Fr.).

Macrophoma Fraxini, Delacr. Bull. Soc. Myc. Fr. 1890, p. 140.

Diplodia inquinans, Westd. Not. ii. p. 14.

Discula macrosperma (Peck) Sacc. var. *Fraxini*, Gr. in Journ. Bot. 1912, p. 52.

Diplodia diatrype, Lév. Ann. Sci. Nat. 1846, p. 292 (f. in *Fraxino*).

II. On *Ribes rubrum*, Pennsylvania, Michener (Herb. Berk. no. 4093!). This is young *Diplodia Ribis*, Sacc., from which *D. Grossulariae*, Sacc. Schulz. does not seem to differ in any respect.

III. On *Viburnum dentatum*, Pennsylvania, Michener (Herb. Berk. no. 4208!). This is a *Botryodiplodia* similar to, if not identical with, *Diplodia Lantanae*, Fckl. Symb. Myc. p. 395, but with the pycnidia evidently immersed in a kind of black stroma. It may be that all species of *Botryodiplodia* have a *Diplodia*-form and that this one should be called *Botryodiplodia Lantanae* (Fckl.). In a similar way it seems likely that all species of *Diplodia* have an earlier small-spored form which would be classed as *Microdiplodia*; the recognition of this probability would help in the understanding of recent discoveries in the latter genus.

SPECIES TO BE TRANSFERRED TO RHABDOSPORA.

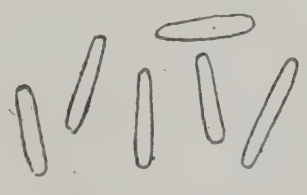
537. Phoma Baculum, *Sacc.*

Rhabdospora Baculum, *Grove.*

Sphaeropsis Baculum, Ger. in Grevill. 1877, v. 151.

Macrophoma Baculum, Berl. & Vogl. in Sacc. Syll. Addit. p. 312.

Pycnidia gregarious, up to 500 μ diam., very black, obtuse, erumpent, but closely surrounded by the epidermis. Spores numerous, cylindrical, straight, obtuse or even truncate at the ends, 14-20 × 2·5-3 μ. (Fig. 17).



R. Baculum.

On branches of *Catalpa*, New Jersey (Gerard, no. 168!).

This species is certainly a *Rhabdospora*, not a *Phoma*; the texture of the pycnidium is very thick and dark. It is accompanied on the branches by a species of *Eutypella*.

SPECIES TO BE TRANSFERRED TO PSEUDODIPLODIA.

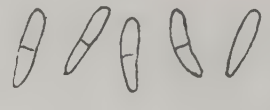
540. Phoma consors, *Sacc.*

Pseudodiplodia ligniaria, *Karst.*, Symb. Myc. Fenn. xv. 156 f. americana, f. nov.

Phoma consorta, Cooke & Ell. in Grevill. 1876, iv. 180, pl. 68, f. 6.

Pycnidia gregaria, 2-5 breviter longitudinaliter seriata, rarissime solitaria, subglobosa vel oblonga, usque 200 μ lata, atra, basi ligno immersa, emergentia fibrisque sericeis cincta,

rugosa, obtusa, poro tandem lato pertusa, postremo dilapsa foveolamque albidam in ligno relinquentia, contextu, mollissimo, olivaceo. Sporulae lineares, utrinque obtusiusculae, saepe curvulae, biguttulatae, continuae, dein medio 1-septatae, 10-14 × 3-3·5 μ, singulae achroae, sed coacervatae dilute olivaceae. (Fig. 18).



P. ligniaria, f. *americana*.

Hab. in ligno decorticato *Aceris*, New Jersey (Ellis, no. 2138!).

The similarity of this specimen, in the texture of the pycnidium and the form of the spores, to my *Pseudodiplodia corticis* (*see* Sacc., Syll. x. 409) leads me to place it in the same genus, while its minuteness shows that it is closely allied to *P. ligniaria*, Karst., though with spores only half as wide as in that species.

SPECIES TO BE TRANSFERRED TO GLOEOSPORIUM.

489. Phoma Aurantiorum, *Sacc.*

There can be no doubt that Saccardo was right in thinking this to be identical with his *Gloeosporium intermedium*, which is, however, a mere form of *G. Aurantiorum*, Westd., concerning which he was misled by Penzig. Three distinct exsiccata, under the name *Sphaeropsis Aurantiorum*, on dry branches of *Citrus*, were examined, viz., the original issue of Dr. Marcucci, dated 1866, and Rabenh. Fung. Eur. no. 1330, both from gardens, Tortoli, Italy, and also Roum. Fung. Gall. no. 90, France, dated 1878: all gave the same result. There is no pycnidium; the spores measure 14-17 × 5-6 μ. and the sporophores are of about the same length: both of them are those indicative of a *Gloeosporium*. The synonymy will therefore be as follows:—

Gloeosporium Aurantiorum, Westd. in Bull. Acad. Roy. Belg. 1854, vol. xxi. no. 19. Sacc., Syll. iii. 702.

G. Hendersonii, B. & Br., Ann. Nat. Hist. 1878, i. 26. Sacc., Syll. iii. 702.

G. intermedium, Sacc. in Mich. ii. 118 (1880); Syll. iii. 702; Fung. Ital. t. 1043.

Sphaeropsis Aurantiorum, Rabenh. no. xxiii. in Marcucci, Unio Itin., Crypt. exs. (1866).

Phoma Aurantiorum, Sacc., Syll. iii. 83.

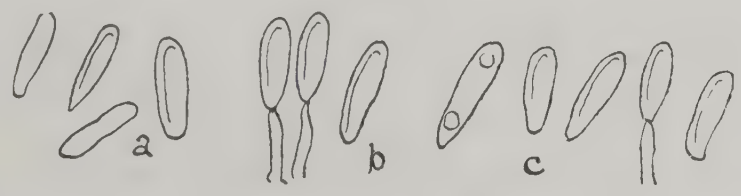
G. Hesperidearum, Catt., Micet. Agrum. p. 12 (*non vidi*). Sacc., Syll. iii. 702; Fung. Ital. t. 1186.

Berkeley's original specimen of *G. Hendersonii* (Herb. Berk. no. 3642!) is exactly the same as *G. Aurantiorum* (Westd. Herb. Crypt. Belg. no. 1188!), both being on half-dead leaves, though the descriptions given are somewhat different, and that given by Penzig at second hand (Mich. ii. 447) is quite unlike, unless one amends it by correcting the length of the spores from "3 μ" to 13 μ. The original description of Westendorp (*l.c.*) gives the spore-measurements as the equivalents of 10-15 × 5 μ. The

specimens issued by Marcucci and Roumeguère are on twigs, but are practically identical with those on leaves. Moreover, judging by the descriptions and figures, *G. Hesperidearum* Catt. is not different, and *G. intermedium*, Sacc. differs only in the sometimes bordered spots, a distinction which arises merely from its occurrence on younger and fresher leaves.

Description of the British specimens, "*G. Hendersonii*. B. & Br."

No distinct spots on the dry leaves. Pustules mainly hypophyllous, densely scattered over the leaf, roundish, 150-230 μ diam., fuscous, surrounded when young by a blackish line, blackish when old, flat, then bullate and erumpent. Spores cylindric-ellipsoid, rounded at both ends, with a faint yellowish tint in mass, often biguttulate, 14-18 × 5-6 μ; sporophores about as long. (Fig. 19).



G. Aurantiorum; *a*, from Rab. no. 1330; *b*, from Roum. no. 90; *c*, from Berk. no. 3642.

On dying leaves of Orange, in a conservatory, Milton, Northts. (Berkeley, Herb. no. 3642!).

SPECIES TO BE TRANSFERRED TO COLLETOTRICHUM.

562. **Phoma tertia,** Sacc.

Sphaeropsis tertia, Cooke in Grevill. 1883, xii. 22.

Macrophoma tertia, Berl. & Vogl. in Sacc. Syll. Addit. p. 307.

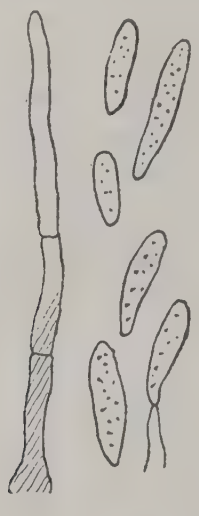
The specimens referred to *S. tertia* by Cooke, on twigs of *Ailanthus*, Aiken, South Carolina (H. W. Ravenel, Fung. N. Amer. no. 2172!), are infested with at least three fungi: (1) a *Colletotrichum*, (2) a *Laestadia* (see below), and (3) a *Diplodia*.

The first of these is the one examined and described by Cooke, which, therefore (if distinct), should bear the name *Colletotrichum tertium*. There are two described species which are very similar, both occurring on petioles of *Ailanthus glandulosa*, (1) *C. Ailanthi*, Togn. Second Contr. Micol. Tosc. p. 16 (in Atti Istit. Bot. Pavia, 1899, v. 16) and (2) *Vermicularia petiolicola*, Brun. Sphaerops. Char. 1889, p. 39 (Sacc., Syll. xiv. 908). The former, however, is credited by the author with falcate spores, and the latter has much longer, darker, more numerous, conspicuous bristles, and differs greatly in outward appearance. *See* Journ. Bot. 1919, p. 341.

(1). Colletrichum tertium, *Grove*.

Pustules densely scattered, flat, round, black, paler in the centre, 100-120 μ diam., disc surrounded by a ring of inconspicuous setae, covered, then emergently bursting the epidermis; setae few (sometimes wanting altogether), tapering to a point,

converging over the disc, olivaceous, paler upwards, very unequal, averaging 60-80 μ long, 5 μ wide at base, septate. Spores straight or rarely curvulous, cylindric-ellipsoid, obtuse at both ends or tapering at base, granular within, 15-25 × 3·5-5 μ; sporophores subconical, 8-10 × 3-3·5 μ.



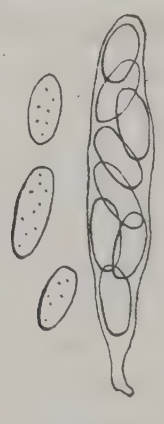
C. tertium.

On small branches of *Ailanthus* (as above).

(2). The pyrenomycete, accompanying this is:—

Laestadia Ailanthi, *Grove* sp. n.

Perithecia subdense sparsa, membranacea, lentiformia, atra, ca. 150 μ diam., tecta, dein erumpentia. Asci clavulati, 60 × 10 μ paraphysibus nullis visis. Sporidia disticha, ovali-fusoidea, intus granulosa ac leviter guttulata, 12-14 × 4-5 μ. (Fig. 21).



L. Ailanthi.

Hab. in ramulis *Ailanthi*, ut supra.

In company with the *Colletotrichum*. The similarity of the spores of these two species is very great, only those of the *Laestadia* are a little shorter, broader, and more fusoid in shape. To the naked eye the size and general appearance of the two fungi are also very similar, and they are mingled indiscriminately on the twigs.

(3). The *Diplodia* referred to is *Diplodia ailanthina*, Speg. (Sacc. Syll. iii. 332) in all essential respects, but would be better described as a non-caespitose form of

Botryodiplodia Ailanthi, *Sacc.* (var. simplex, m.).

The pycnidia are much smaller and less erumpent, and at most subgregarious (not in clusters); the spores are longer and broader (28-32 × 12-14 μ). In *Botryodiplodia Fraxini* it is possible to trace all imaginable forms intermediate between the so-called *Macrophoma Fraxini* and the most congested state; as has been shown in another place, facts require us to believe that a fungus of this group can vary from a scattered to a fasciculate state, from one which has colourless spores (when young) up to one which has dark brown spores (when mature), and from continuous to uniseptate spores, all these being mere time-phases of the same species and often to be found intermingled on the same twig or branch. The same thing is no doubt true of the species on *Ailanthus*; there is always a tendency in both for the simpler forms to grow upon the smaller branchlets.

A few short notes on other species which have been examined may now be added:—

442. Phoma enteroleuca, *Sacc.*

This is represented in the Herbarium by four specimens, all different, and none of them agreeing with Saccardo's description, which seems to be that of an abnormal state of some common species in which the cavity of the pycnidium was filled with a subsclerotial growth of cells, such as is not infrequently met with, and which is in most cases the preparation for the production of ascospores. Probably the "species" can never be recognised again with certainty.

447. Phoma Rubi, *Westd.*

"Phoma Ruborum, Westd.," ex errore in Sacc., Syll. iii. 76.

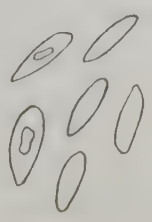
This specimen of Westendorp, on small branches of *Rubus*, is a *Cytospora*, and is indistinguishable from some of the forms assigned to *C. ambiens* which appear on *Rubus*; the spores measure about 6 × 1 μ, though sometimes larger.

Phoma Ruborum, Roum. Fung. Gall. no. 3563! is quite different; it has hyaline didymous spores and a disc surrounded by a few olivaceous setae.

459. Phoma Granati, *Sacc.*

Macrophoma Granati, Berl. & Vogl. in Sacc. Syll. Addit. p. 315.

The description is correct, except that the spores are often 1-guttulate, faintly coloured in mass, 10-15 × 4-5 μ. (Fig. 22.)



P. Granati.

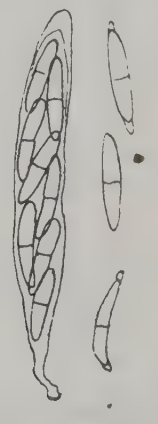
460. Phoma Eucalypti, *Cooke & Harkn.*

Certainly not a *Phoma*; a vague mycelial growth, in which few and uncertain spores and absolutely no pycnidium could be detected.

461. Phoma Eucalyptica, *Sacc.*

Coniothyrium Eucalypti, Thüm. 1879, Moller, no. 401!

Specimens very imperfect, with few pycnidia or spores. But, on the other hand, there were a large number of perithecia of *Didymella recedens*, Sacc., with asci and biseriate spores, 16 × 3 μ, bearing at each end appendages 1 or 2 μ long. (Fig. 22.



D. recedens, from Moller, no. 401.

465. Phoma longispora, *Cooke.* *Leptothyrium longisporum*, Thüm.

Macrophoma longispora, Berl. & Vogl. in Sacc. Syll. Addit. p. 312.

There are, under this name, a number of specimens (Ravenel, no. 2605!), as issued by Cooke, on branches of *Vitis aestivalis*, from Aiken, South Carolina. On these no spores like those described by Thümen could be detected. But there was a considerable quantity (mostly immature) of *Guignardia Bidwellii* (Ellis) V. & R. = *Physalospora Bidwellii*, Sacc., Syll. i. 441. Not a few asci and spores were found quite mature, and agreeing exactly with the descriptions and figures. As these specimens were issued in 1879, while Dr. Bidwell found the perithecia for the first time in 1880, it is evident that Ravenel really collected them first. His specimens are on the stems, which are surrounded and covered by vast numbers of perithecia.

469. Phoma confluens, *Berk. & Curt.*

The specimens in Herb. Berk. (no. 5616!) are very imperfect; this species should be deleted.

478. Phoma fraxinea, *Sacc.*

So far as the specimens, Roumeguère, no. 4350!, are concerned, this does not differ from *Cytospora ambiens*, Sacc. on the same host.

484. Phoma Syringae, *Berk. & Curt.* (see Sacc., Syll. iii. 82, sub *Phoma syringica*).

This specimen (Herb. Berk. no. 3191!), from South Carolina, is *Phomopsis depressa*, Trav., not *Phoma syringica*, Thüm. It has biguttulate fusoid spores, 7-9 × 2-2·5 μ.

490. Phoma Limonis, *Thüm.*

This is represented in Herb. Kew by a specimen from de Thümen (Gorizia, Mycoth. univ. no. 1193!), on which there are at least four apparently different minute fungi (one of them *Metasphaeria papulosa*, Sacc.); but none of them agrees with the description of the *Phoma*.

533. Phoma macropus, *Berk. & Curt.*

On an unknown host (New England, Sprague, Herb. Berk. no. 5695!). The external appearance resembles Berkeley's description, but no spores or sporophores such as he assigns to it, nor any others, could be found. This species should be deleted.

551. Phoma tamaricella, *Sacc.*

There cannot be the slightest doubt, after examination of the specimens, that this is merely the same as *P. tamaricina*, Thüm.

558. Phoma stictina, *Sacc.*

Coccularia stictica, Berk. in Grevill. 1874, ii. 97.

Represented by two exsiccata (Herb. Berk. nos. 1532! and 2235!). On these nothing is apparent but nodular subsclerotial mycelial growths.

559. Phoma sphaerospora, *Sacc.*

On this specimen (Roum. Fung. Gall. no. 3969!), on samarae (*not* branches) of *Ailanthus*, nothing is visible but knots of mycelium and various other stages of a *Pleospora* (not *P. herbarum*).

561. Phoma ailanthina, *Thüm.*

On examining Thüm. Mycoth. unic. no. 989! there could be found only a species of *Coniothyrium*, with a small quantity of another (undeterminable) fungus. Those species of *Coniothyrium* which have nearly colourless spores when young have often been mistaken for a *Phoma*, as here.

IX.—THE TRUE MAHOGANIES.

R. A. Rolfe.

Of late years extensive planting of Mahogany trees has taken place in Trinidad and some other colonies, and numerous specimens and fruits have been received at Kew with the enquiry as to whether they represent the true plant. Mahogany has

long been known as the timber of a tree called botanically *Swietenia Mahagoni* Jacq., usually said to be a native of the West Indies and the adjacent coasts of Central America, but the term has also been extended to other red-brown timbers possessing somewhat similar properties, some of them belonging to other genera of *Meliaceae* and some to quite different families. The term, however, was originally applied to the West Indian tree, the timber of which has been known for upwards of 300 years, and under the name of Spanish Mahogany, early became famous for the construction of articles of furniture. At a somewhat later date British Honduras became famous as a source of Mahogany, which until 1886 was generally regarded as the timber of *Swietenia Mahagoni*. In that year, however, Sir George King described and figured a new species under the name of *Swietenia macrophylla*, this having been grown in the Royal Botanic Gardens, Calcutta, from seeds collected in Honduras. Since then it has been generally recognised that Honduras Mahogany is specifically different from the West Indian tree. There is also a third species, *S. humilis*, Zucc., a native of Western Mexico, which was thought to be in cultivation at Calcutta. Specimens of the Calcutta tree, however, including fruits, have recently been received at Kew, and prove to be a form of *S. Mahagoni*, Jacq. Further species formerly referred to *Swietenia* have now been transferred to other genera. The present paper, however, is limited to the species of *Swietenia* proper, to which what may be termed true Mahoganies belong.

1. **Swietenia Mahagoni,** Jacq. (Enum. Pl. Carib. p. 20), dates from 1760, being based on the *Arbor foliis pinnatis nullo impari Alam claudente*, &c., Catesby (Nat. Hist. Carolina, Florida and the Bahama Islands, ii. p. 81, t. 81), published six years earlier. It is called the Mahogany tree, and is said to grow in the Bahamas and other countries. Catesby remarked: "The Excellency of this Wood for all Domestick Uses is now sufficiently known in England: And at the Bahama Islands, and other Countries, where it grows naturally, it is in no less Esteem for Shipbuilding, having Properties . . . . viz., Durableness, resisting Gunshots, and burying the Shot without Splintering." The coloured figure, which is good, shows a branch with flower and fruit, and also a Mistletoe which is said to grow on Mahogany and other trees in the Bahamas.

It is said that the earliest specimens of Mahogany were brought home by Sir Walter Raleigh on his return from Trinidad in 1595 (Dict. Nat. Biogr. xlvii. p. 194). The name, however, does not seem to have been used previous to 1671, when John Ogilby (America, p. 338), remarks "Here [in Jamaica] are . . . the most curious and rich sort of Woods, as Cedar, Mohogeney," (&c.).

P. Browne, in 1789 (Hist. Jam. p. 158), calling it *Cedrela* 2, states that "Mahagany grew formerly very common in Jamaica, and while it could be had in the low lands, and brought to market at an easy rate, furnished a very considerable branch of the exports of that Island." This is followed by an excellent

account of the tree and its timber. He then goes on to speak of "another Cedrela" discovered by Mr. Houston near the Gulf of Honduras, which is apparently identical with *Swietenia macrophylla*.

In 1824 Kunth mentions *Swietenia Mahagoni* as growing in Mexico (Syn. Pl. Æquinoct. iii. p. 219). The references cited are correct, but the diagnosis and habitat evidently belong to *S. humilis*, Zucc., for he describes the leaflets of the plant collected by Humboldt and Bonpland as "acuminato-subulatis," and remarks "Crescit prope Acupulco Mexicanorum, portum Oceani Pacifici."

In the same year De Candolle alluded to figures by Gaertner and Moçino & Sesse as showing the fruit dehiscing at the apex, and asked whether two species might not have been confused or whether the dehiscence was variable (Prodr. i. p. 625). The figure of Moçino & Sesse we have not seen, but that of Gaertner represents the West Indian *Swietenia Mahagoni*, and is dehiscing at both ends, like specimens now preserved at Kew.

In 1830 Sir William Hooker published an exhaustive account of the Mahogany tree, accompanied by two plates prepared from drawings made in St. Vincent by the Rev. L. Guilding (Bot. Misc. i. pp. 21-32, tt. 16, 17), and here, after an account of the extensive use of Jamaica Mahogany, he remarks: "Now, I believe, a very large portion of the Mahogany imported into Great Britain is derived from the Honduras, where it is unquestionably produced in most abundance." On a later page allusion is made to Browne's remarks, and it is added, "If this be what we call the Honduras Mahogany, and different from that of Jamaica, it is much to be lamented that its botanical characters are not yet known to us." This is the plant now known as *S. macrophylla*, King.

In 1879 Hemsley enumerated *Swietenia Mahagoni* as Central American (Biol. Centr.-Amer. i. p. 183), but the Honduras specimens cited belong to *S. macrophylla*, King, and those from Acapulco and Nicaragua to *S. humilis*, Zucc.

Complete materials of a *Swietenia*, which has long been cultivated at Calcutta under the name of *S. humilis*, have been sent to Kew by Lt.-Col. A. T. Gage, and seem to represent a dwarf form of *S. Mahagoni*, the leaflets and fruits being very similar in general character. It is not the *S. humilis*, Zucc.

The following are references to the literature and synonymy of *S. Mahagani*, including such figures as are accessible to us:—

Swietenia Mahagoni, Jacq., Enum. Pl. Carib. p. 30; Linn. Sp. Pl. ed. 2, p. 548; Cav. Diss. p. 365, t. 209; Gaertn. Carp. ii. p. 89, t. 96; Hayne Arzn. Gewächse, i. t. 19; DC. Prodr. i. p. 625; Woodv. Med. ed. 2, iii. p. 620, t. 220; Desc. Antil. ii. p. 125, t. 99; Dict. Sc. Nat. xxviii. p. 81, t. 170; Tussac. Antil. iv. p. 65, t. 23; Hook. Bot. Misc. i. pp. 21-32, tt. 16, 17; Spach, Hist. Nat. Veg. iii. p. 164, Atlas, t. 21; Schnitzl. Ic. Fam. Nat. iii. t. 226, fig. 1; Nutt. Sylva, ii. p. 45, t. 75; DC. Monogr. Phan. i. p. 723, t. 8, fig. 11; Engl. & Prantl. Pflanzenfam. iii. p. 274, fig. 153.

The species is widely diffused, occurring in the Keys of S.

Florida, the Bahamas, Cuba, the Cayman Islands, Jamaica (said to be common on the plains and lower hills up to 3000 ft.), Hispaniola (Hayti and San Domingo), Porto Rico, St. Thomas, St. Croix, Martinique, St. Vincent, and Trinidad, though according to Crueger it is not indigenous in the latter island. De Candolle adds "Peru, near Pazuzo, Ruiz in h. Berol.", but this requires confirmation. The other localities, Mexico and Honduras, mentioned in various works, belong to the two following species.

2. **Swietenia humilis,** Zucc., was described and figured somewhere between 1831 and 1836 (Abh. Akad. Muench. ii. p. 355, tt. 7A, 7B), being based on materials collected by Karwinski in dry regions at 1000 ft. elevation near Tehuantepec, on the coast of the Pacific Ocean. It is described as a medium-sized tree, some 20 to 30 ft. high, with a trunk scarcely two feet in diameter, and the wood hard as in Mahogany. It was said to flower in February and to mature its fruits in the same month a year later. This species is characterised by its moderate-sized, very acuminate leaflets and by the very distinctly umbonate fruits. There are specimens at Kew from Taretan, in the Province of Oaxaca, collected by Prof. A. Duges, in 1883, bearing the native name "Cobano"; from Tuxtla, in the province of Chiapas, collected by Ed. Seler, and from Realejo (or Corinto), N.W. Nicaragua, collected by Dr. Sinclair. The latter is labelled "Mahogany Tree," and is cited by Hemsley under *S. Mahagoni*, Jacq. It would be interesting to ascertain whether this is the source of what is known as Nicaragua Mahogany. All these localities are on the Pacific Coast, as is also Acapulco, where Humboldt and Bonpland collected a Mahogany that is suspected to belong to this species (Kunth, Syn. Pl. Æquinoct. iii. p. 219). This and the Nicaraguan plant are cited by Hemsley under *S. Mahagoni* (Biol. Centr. Amer. i. p. 183). Another figure is Schnitzl. Ic. Fam. Nat. iii. t. 226, fig. 2, 4, 5, 7, 8, 18, 21, 22.

De Candolle cites as a synonym of this species *Swietenia multijuga*, Schiede (Linnaea, iv. p. 578), but this is a species of *Cedrela*. It was afterwards called *Cedrela odorata*, L.? (Schlecht. & Cham. in Linnaea, vi. p. 422), and later (as it is different from *C. odorata*, L.) *C. mexicana*, Roem. (Syn. Monogr. Hesperid. p. 47). There is a fruiting specimen of *S. multijuga* in the Natural History Museum at South Kensington, the leaves having eight pairs of alternate, very acuminate leaflets, and the fruits and seeds are wholly typical of the genus Cedrela. Of this Schiede remarked: "It is abundant at Papantla, Estero, and probably in the whole region, and is known by the name of Cedro. The wood of this tree is a browish colour, is easy to work and supplies the place of the Pines in the tract of coast. It must not be confounded with the Cedro of the Tierra fria, which is *Taxodium distichum*." The locality, it will be noted, is on the Atlantic coast of Mexico.

He also mentions a similar hard wood, called Caoba, perhaps produced by another species of the genus *Swietenia*, but he did not know the tree which produced it, though it was said

to grow not far from Papantla. This record is particularly interesting, because there is a specimen at Kew from the Herbarium of J. N. Rovirosa (n. 181), labelled "Caoba incolarum. Habitat. Comun en las cercainas del pueblo de Tepitan (Tabasco), Mexico, Feb. 14, 1888," which enables Schiede's "Caoba" to be definitely identified. Though labelled *Swietenia Mahagoni* it is a specimen of *S. macrophylla*, King.

3. **S. macrophylla,** King.—In 1886 Sir George King figured and described a new species of *Swietenia* under the name of *S. macrophylla* (Hook. Ic. Plant. t. 1550). The tree had been grown in the Botanic Garden, Calcutta, from seeds stated to have been collected in Honduras in 1872. *S. Mahagoni* was also grown at Calcutta, and it was pointed out that the Honduras plant had leaves twice as large as the other, with still larger leaflets, in 5 or 6 pairs, not in 4, and that both capsules and seeds were larger. It also flowered a month earlier than *S. Mahagoni* and seeded freely, whereas the other rarely seeded there at all. The differences were observed as soon as the seedlings were a few inches high, they grew much more rapidly, and were planted out as *Swietenia* species. They also grew three times as fast as *S. Mahagoni*, and in their twelfth year had attained a height of 20 ft. and had begun to flower freely, and a year later produced capsules. *S. Mahagoni*, at Calcutta, did not seed until 30 or 40 years old, and at all times very sparingly. This is the species which is at present being extensively planted in Trinidad and elsewhere. It now remains to collect the threads of its earlier history.

In P. Browne's History of Jamaica, published in 1789, we find (p. 159) a *Cedrela* n. 3, *Caroli foliolo ampliori, fructu pentagono*, Houst. apud Mill., of which it is remarked: "This plant does not grow in Jamaica, and is only inserted here to show that there is another species of the kind known: it was discovered by Mr. Houston near the Gulf of Honduras, where it grows very large." Whether this really represents *Swietenia macrophylla*, King, is not quite clear, for no trace can be found of a *Swietenia* in Houston's MSS., and plants at the British Museum, together with the absence of any mark to the Cedrelas in the British Museum copy of Miller's Gardeners' Dictionary, would indicate that no specimens were found in Miller's Herbarium in the same establishment, for it is on record (Journ. Bot. 1897, p. 225) "someone (probably Dryander) has marked off in the Gardeners' Dictionary the species received from Miller." It is not quite certain that the species alluded to by Browne is a *Swietenia*, for Miller's 3, *Cedrus (Alaternifolius) foliis alternis simplicibus cordato-ovatis acutis*, which is said to have been discovered by the late Dr. Houston at Campeachy, must have been different. It is reiterated that the leaves are single, while in the two preceding ones they are described as pinnate. The trees are said to be "eighty feet or upward, leafless on Houston's first visit, but on his second visit clothed with verdure, but with no appearance of flowers, so he was at a loss to know what genus it belonged to." Miller, however, remarked: "As the

fruit of this tree agrees exactly with those of the two former species [the Barbadoes Cedar-tree and the Mahogany], I have ventured to join it to them." And it is added, "We have no account of the wood of this tree, whether it is ever used in buildings, or for other purposes, as there have been few persons of any curiosity in that country, the cutters of logwood being the chief people who inhabit there, from whom there can be little known of the produce." The above reference is to the sixth, or 1771, edition of Miller, and there is no addition to the history in later editions.

There is evidence that Honduras Mahogany was known before Houston visited Campeachy. Sir Daniel Morris in 1883 remarked, "British Honduras began, some two hundred years ago, as a logwood and mahogany-cutting settlement" (Brit. Honduras, p. 1), and a few pages later (p. 4) "Additional articles to the Treaty of 1783 were made in 1786, at a convention held in London, whereby the right of cutting Mahogany was formally granted." It was, however, not distinguished from the West Indian species, for it is further remarked (p. 61) "Chief amongst the timber trees of the colony comes the mahogany (*Swietenia mahagoni*), which, with logwood, forms the staple article of export. The average quantity of mahogany shipped from British Honduras during the last five years amounts to nearly 3,000,000 feet, of the annual value of £30,000. The best qualities of mahogany . . . . come from the limestone soils of the north of Belize; those from the south, and especially from the Mosquito Coast, being deficient in density and fine grain, are known in England as baywood."

In 1829 Sir William Hooker included the localities of all the three species under *S. Mahagoni*, but he gave some details of Honduras Mahogany, referring to Browne's remarks as to its distinctness, adding that workmen made an important distinction between the two woods, and that the Jamaica kind was the most valuable.

Apart from Sir George King's description of *S. macrophylla*, the only other reference to the question under consideration that we have found is in the West Indian Agricultural News for 1902, where, in a note entitled "Jamaica and Barbados Mahogany" (i. p. 54) we read, "It has been shown by Mr. Hart at Trinidad that the Mahogany trees so commonly grown at Jamaica, Barbados and elsewhere in the West Indies, are somewhat different from the Mahogany trees of British Honduras. The latter are said to be stronger-growing, while the leaves are larger and of a different shape." Since that time the differences between the two species have been fully recognised.

Very little is known about the distribution of *Swietenia macrophylla*, but besides the specimens from Tabasco and Honduras, preserved at Kew, there is also one from Cartagena, on the north coast of Colombia, east of Panama. This was sent by M. Antoine under the name of Mahogany, and if correctly localised and indigenous there, would indicate a possible wide distribution of the species in the countries bordering on the Caribbean sea. Unless there is more than a single species,

S. macrophylla is evidently the source of Honduras and Tabasco Mahogany, both well known on the market, but other Central American woods are known under the names of Costa Rica, Nicaragua, Guatemala and Panama Mahogany, the botanical source of which is in doubt. Colombia Mahogany, though shipped from Cartagena, is not a *Swietenia*, but the produce of *Cariniania pyriformis*, Miers, belonging to the family *Lecythidaceae*. It is said to be cut in the former state of Bolivar, 100 to 200 miles inland, and shipped from Cartagena.

Very close to *Swietenia macrophylla*, if not a form of the same, is a plant sent for determination by Sir Norman Lamont, who raised it from seeds of the second consignment obtained by the Trinidad Department of Agriculture from Honduras, somewhere about 1905. It is said to be about equal in height to undoubted *S. macrophylla*, planted at the same time, but is rather more branching and the branches have a less pronounced vertical habit. The leaves are rather smaller than in *S. macrophylla*, the inflorescence denser and the flowers rather smaller, but the general resemblance is so close as to suggest that it is only a varietal difference. The tree flowered profusely in 1918, but only a single fruit set, which has been sent to Kew, and cannot be separated by any essential character.

A tree with very similar leaflets is cultivated at Madras, a barren specimen, labelled "*S. macrophylla*, G. King, introduced, A. H. G., Madras, July, 1897," being preserved at Kew.

It would be interesting to identify the trees which produce other Central American Mahoganies, for example, Costa Rica, Nicaragua, Guatemala and Panama Mahogany, and for this flowering and fruiting specimens are desired. The term Mahogany is now applied to the timber of so many trees that nothing short of the actual materials will serve to identify them. All the timbers named may not belong to *Swietenia*, but in any case it is desirable that their botanical source should be ascertained.

X.—MISCELLANEOUS NOTES.

E. H. Wilson.—We learn that Mr. E. H. Wilson has been appointed Assistant Director of the Arnold Arboretum, Jamaica Plain, Mass., U.S.A.

Drawings of Indian Plants.—A set of about 600 water-colour drawings of Indian plants has recently been acquired for Kew. They are evidently the work of several artists, some of them native, others European, and appear to have been at one time the property of Claude Martin, who was born at Lyons on Jan. 4th, 1731, went to India in 1751 and, as an officer of the English East India Company, served in the Carnatic wars. In 1763 he obtained an ensign's commission in the Bengal Army, in which at length he became Major-General, retiring on half-pay in 1776, when he was allowed to accept the post of superin-

tendent of the arsenal of the Nawab of Oudh at Lucknow, where he died on Sept. 13th, 1800. He bequeathed his fortune to found institutions—called "La Martinière"—for educating European children at Lucknow, Calcutta and Lyons. Most of the drawings have been named by Dr. William Roxburgh, who was superintendent of the Botanic Garden, Calcutta, 1793-1814, and described some new species in his "Flora Indica" from material obtained from Martin, who was living at Lucknow part of that time. Under *Andropogon Martini*, Roxb., l.c. sp. 277 (= *A. Schoenanthus*, var. *Martini*, Hook. f.), a note states:—"A native of the high lands of Balla-ghat. General Martin collected the seeds while there with the Army, during the last war with Tippo Sultan, and has reared abundance of it at Lucknow." Roxburgh, in vol. iii. p. 421, when describing *Artemisia elegans* (= *A. scoparia*, Waldst. & Kit.), says:—"Received from General Martin at Lucknow under the name of Abbuttna." Martin must have taken an interest in plants before he settled in Lucknow, for when describing *Caesalpinia sepiaria*, Roxburgh (l.c. ii. 360) calls it the Mysore Thorn and says that it "was introduced into Bengal from that country by General Martin, where it is now as common as it is in the Mysore country, and is used to make fences." One drawing has attached to it an undated letter from Dr. Robert Bruce, a surgeon at Lucknow in Martin's time, which reads thus:—"My dear Martin—The flower is very well done. It is called in botany by a pompous name, the Gloriosa superba, and is, I fancy, the most beautiful of all the Lily tribe. The paper is infinitely superior to the country kind for covering drawings. Having already some of it I won't rob you of yours, but beg your acceptance of my best thanks. I have, however, kept one of the sheets which was of folio size just suited to the size of the drawing paper, which I shall send down to Calcutta as a muster. Yours ever, R. Bruce."

The drawings appear to have passed into the possession of Sir Gore Ouseley, who went to India in 1787, where after a few years he became Major-Commandant in the service of Saadut Ali, Nawab of Oudh, and was stationed at Lucknow at the time that Martin lived there. He returned to England in 1805. Later the collection came into the hands of his son, Sir Frederick Arthur Gore Ouseley, Professor of Music at Oxford University, and afterwards into the possession of Mr. F. W. Barry, Assistant in the Library, Windsor Castle, from whom they have been acquired by Kew.

With this collection are other drawings on smaller-sized paper, representing plants from the Caucasus or Northern Persia, which may have been made for Sir Gore Ouseley, who (accompanied by his elder brother, Sir William Ouseley, as private secretary) was Ambassador-Extraordinary and Minister-Plenipotentiary to the Persian Court from 1810 to 1814, and was at Tabriz in Northern Persia in June, 1912. Many of these drawings are exquisitely finished.

C. H. W.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 5] [1919

XI.—THE FALKLAND ISLANDS.

FORESTRY. TUSSOCK GRASS.

W. DALLIMORE.

The records of the Royal Botanic Gardens, Kew, indicate that on several occasions between 1842 and the present date correspondence has taken place between the Governor of the Falkland Islands and other individuals, the Colonial Office, and the Director of the Royal Botanic Gardens, Kew, respecting trees suitable for experimental planting in the Islands, and the advisability of planting the Falkland Islands Tussock Grass extensively in certain parts of the British Isles; therefore, in view of recent interest shown in the two subjects, the following notes have been prepared.

FORESTRY.

In order that the difficulties which beset the islanders when considering the establishment of trees may be understood, it is necessary to give a few details respecting the geographical position of the islands and the prevailing physical and climatic conditions.

* They are situated in the South Atlantic Ocean, between 51° and 53° S. lat., and between 57° and 62° W. lon., about 480 miles N.E. of Cape Horn, and about 1000 miles due south of Monte Video. They consist of East Falkland (area 3000 square miles), West Falkland (2300 square miles), and about 100 small islands, with an area of nearly 1200 square miles. The surface is undulated with Mount Adam, the highest ground, rising to 2315 ft. above the level of the sea. The entire country is wild moorland with outcrops of rocks and wide stone runs which litter large areas of the valleys with stones. Much of the soil is peat, often of a wet and boggy nature. In other places it is loam or clay, and in some instances peat over-lies clay of such tenacity that natural drainage is almost impossible and the peat becomes semi-liquid. There are, however, areas

* Colonial Office List.

(448.) Wt. 158—829. 1,125. 7/19. J. T. & S., Ltd. G. 14. Sch. 12.

of fertile soil suitable for potatoes, cabbages, turnips, oats and other agricultural crops, whilst various vegetables, currants, gooseberries and raspberries can be grown in sheltered gardens. Oats rarely ripen but are grown as a green fodder crop. There is naturally a great shortage of lime in the soil and agricultural lime cannot be easily obtained from other countries to correct the acidity of sour soil. Occasional movements of bog land on the hills and mountains take place, and in several instances such movements have caused the inhabitants a good deal of inconvenience.* The only roads in the islands are in the neighbourhood of Port Stanley, communication between the various points being by sea or on horseback.

The climate is severe but healthy, except for those predisposed to pulmonary affections. It is uniformly cold, the mean temperature being 42° Fahr. The thermometer ranges between 20° and 50° in winter, and between 40° and 65° in summer. The cold is intensified by constant high winds which prevail, especially in the summer, rising about 10 a.m. and falling away between 4 and 5 p.m. The annual rainfall seldom exceeds 25 in., though there are a good many wet or damp days, the number ranging between 220 and 240 a year. In the summer the atmosphere is remarkably dry, and evaporation is rapid. The population in 1915 was 3451,† the majority of the people being engaged in sheep farming or in seafaring industries.

The flora consists of herbaceous plants and shrubs. The largest bush is *Veronica elliptica*. A few plants approaching 7 ft. in height have been recorded from West Falkland, otherwise its average height is from 3 to 5 ft. *Chiliotrichum amelloideum* (Fachina), grows 3 to 4 ft. high and *Myrtus nummularia* is also prominent. The commonest shrub is the "Diddle-dee" (*Empetrum nigrum* var. *rubrum*), which is found from a prostrate plant to dense, rounded bushes 1 to 2 ft. high. A few of the other low-growing shrubs are *Pernettya empetrifolia* (*P. pumila*), *Gaultheria microphylla*, *Baccharis magellanica*, and *Veronica serpyllifolia*. *Poa flabellata*, Hook. f., the "Tussock" or "Tussac" Grass, a large-growing perennial at one time the most prominent feature of the shores but now scarce on the larger islands, is a valuable fodder plant, otherwise the natural vegetation is poor as fodder, and only carries one sheep to four acres.

The chief difficulties to encounter in forestry operations appear to be wind, wet, sour and badly drained ground, and apathy or lack of initiative and knowledge on the part of the inhabitants. But considering the difficulties that have been surmounted in other countries where successful forests have been established under what were equally disheartening conditions, there appears to be no good reason why the subject should not be given a proper trial, for in a place where natural trees do not exist, the establishment of woods of even moderate growth would be of great benefit to the islanders both from the shelter they would afford, and as a source of firewood and timber for fencing.

The general amenities of the Islands would also be much

* Kew Correspondence.

† Whitaker's Almanack, 1917.

improved should successful forests be established. From the time when the earliest emigrants entered the country the absence of trees appears to have made the greatest impression upon newcomers, and from the middle of last century successive Governors and a few of the more progressive settlers have considered the possibility of establishing trees either for ornament or profit. Planting schemes, usually of a very half-hearted character, have been suggested from time to time, but, whether from apathy, lack of general sympathy, or the disinclination to risk money on a project that could only be considered in the light of an experiment, they have not materialised, and the introduction of young trees or tree seeds has not gone beyond the individual efforts of a few settlers and a few attempts by Government officials to procure trees and shrubs for the garden at Government House. Unfortunately in the few efforts that have been made the persons interested have not possessed sufficient technical knowledge to enable them to give the young trees the special attention necessary to enable them to overcome the unfavourable conditions which prevail, neither have they made proper reports upon the behaviour of the various species tried, therefore the position has not altered from what it was when Col. Moody, the first Lieut.-Governor of the Islands, took office in 1842.

During that year the Ross Expedition wintered in the Islands and the Governor apparently became interested in plant life partly through the enthusiasm of Dr. (Sir Joseph) Hooker, one of the officers of the expedition. The first information we possess of trees and shrubs being introduced into the Islands is a *despatch from Governor Moody to Lord Stanley at the Colonial Office, dated 16th November, 1842, advising him that the Antarctic Expedition (Captain Ross) returning from St. Martin's Cove, Cape Horn, brought to the Colony 700 young trees, chiefly winter barks, beeches, and holly-leaved berberies, &c., and that the trees were immediately planted with hopes that they might succeed. We know nothing of the fate of those trees save that on 1st February, 1844, the Governor, in a letter to Sir William Hooker, reported that the elder trees and the Antarctic beeches in the graveyard were doing well.

The next information we have of trees and shrubs being sent to the Falklands is a list of plants forwarded from Kew on 27th December, 1848. The plants were:—*Arbutus Unedo*, *Aucuba japonica*, *Berberis Aquifolium*, *Betula alba* 2, *Buxus sempervirens* 2, *Colutea arborescens*, *Crataegus orientalis*, *C. Oxyacantha*, *Cytisus albus*, *C. scoparius* 2, *Elaeagnus orientalis* 2, *Euonymus japonicus*, *Fagus sylvatica*, *Garrya elliptica*, *Hedera Helix*, *Hippophae salicifolia* 2, *Ilex Aquifolium*, *Laburnum vulgare*, *Ligustrum vulgare*, *Picea alba*, *Pinus Laricio* 2, *P. montana* var. *Mughus* 2, *P. Pinaster* 2, *P. rigida* 2, *P. sylvestris* 4, *Platanus*? [*Ulmus*] *campestris*, *Platanus orientalis*, *Prunus Laurocerasus*, *P. lusitanica*, *Quercus pedunculata*, *Q. sessiliflora*, *Q.* sp., *Ribes alpinum* 2, *R. aureum*, *R. Menziesii*, *R. nigrum* 2, *R. sanguineum*, *Rosa* sp., *Salix Caprea*,

* Information respecting the Falkland Islands. Chas. Knight, 1843.

S. lanigera? *Spartium junceum*, *Spiraea Lindleyana*, *Syringa vulgaris*, *Taxus baccata*, *T. b.* var. *fastigiata*, *Thuya occidentalis*, *Tilia* sp., *Ulex europaeus* 4, *Vinca major*, *V. minor* and the following fruits:—Currant, white 6, Currant, red 6. Gooseberry 6 varieties, 12 plants, Raspberry, double bearing 6, R., Yellow Globe, 6, R., Fastolff 6, Blackberry (*Rubus fruticosus*). Whether these plants arrived safely and became established is unknown, but it appears likely that the plants of *Ulex europaeus* may have been the parents of the numerous Gorse plants now present in the Islands. The Laburnum is still to be found in one or two places.

Their introduction does not appear to have made much difference to the general aspect of the Islands, for in 1870 the Governor, Col. G. D'Arcy, wrote on 2nd May to Sir Joseph Hooker that "the people of the settlement are very industrious and very anxious to help themselves by raising vegetables, but the wind actually blows the seed out of the ground," and asking whether in his wide experience he could suggest any hardy tree or bush to make a fence. He added, "there is not a tree or bush on the islands of any kind." He had apparently overlooked the Veronica, and Sir J. Hooker suggested that he should try that.

In 1886, Mr. Arthur Barkly, recently returned from the Seychelles, relieved Governor Kerr for a year. After the luxuriant plant growth of those islands he was unfavourably impressed by the bareness of the Falklands, and during his term of office wrote to Kew for seeds or roots of any hardy bushes or shrubs that would be likely to thrive; he thought that they might be expected to grow 12 or 15 ft. high, and that evergreen bushes would greatly improve the appearance of the country. It is not very clear whether seeds were sent on this occasion but on 10th June, 1891, a letter was received at Kew from the Colonial Office saying that the Government of the Falkland Islands wished for a small supply of seeds and plants, and asking for the advice of the Director as to selection and packing. Seeds for indoor and outdoor cultivation were obtained from Messrs. Sutton and included Palms, Crotons, Caladiums, Magnolias, Laurestinus, Azalea, Arbutus, Roses and Hardy Ferns. A more comprehensive list of plants was sent, however, with the approximate price, apparently, for approval, but it appears to have been rejected on account of expense. The Governor, however, was determined to procure seeds, and the Colonial Secretary of the Falklands on his return home in 1891 was requested to approach Dr. (Sir Daniel) Morris regarding plants or seeds. In the end it was decided that an amount not exceeding £10 should be spent on seeds and plants, the amount to include packing. The order was executed by Messrs. Veitch, of Chelsea, and seeds of a variety of trees, including Pines, Birches, Poplars, etc., were sent on 17th January, 1893.

In 1893 Mr. Edward Rawlings wrote to Kew for advice respecting *Pinus insignis*, as his nephew, Mr. R. E. Nichol, was desirous of attempting a plantation in the Falkland Islands.

About 25 or 30 years ago Mr. Robert Blake, a prominent sheep farmer in the Falklands and now a Director of the Falk-

land Islands Company, made what was probably the most determined attempt that has yet been undertaken to establish a plantation of trees in the Islands. Unfortunately he left the Islands in 1898 and was thus unable to give the young trees personal attention. They, however, made fairly good progress and some reached the height of 30 ft. A few years ago they were reported to have lost their heads as soon as they rose above their shelter.* Mr. Blake, in giving Kew the benefit of his experience, writes: "I may be optimistic but I honestly believe many places in the Falklands could be planted with trees and that they would flourish. It must always be remembered in those latitudes that the further west one travels the warmer the climate and that the north coast of the Islands is warmer than the southern shores. This, no doubt, is accounted for by the cold current which runs continuously from west to east, passing south of the Islands; this is not felt on the northern coasts. I fear the situation of Port Stanley is not at all suitable for tree raising experiments. I think, therefore, in making experiments these should be carried out on the north coast of the West Island. Native bushes like the Fachina, Veronica and Diddle-dee grow far larger in the north of the West Island, also there is a marked difference in some of the grasses and herbs, all going to show that the climate on the west is milder than on the east. . . . In Tierra del Fuego, with a climate far more rigorous than ours, bushes and trees grow freely. I have been able to bring a few of these bushes to the Islands—the Antarctic Beech (*Nothofagus* spp.), a kind of Laurel (*Laurelia serrata*), and Calafate (*Berberis buxifolia*)—they grow freely at Hill Cove, on the West Island. My first experiment was taking out some small Austrian Pines. Many survived the voyage and grew quite well, then I tried seeds of Austrian and Scots Pines and had no difficulty with them. I transplanted several hundreds when they were about 6 in. high in 1898 [apparently the trees mentioned by Skottsberg] when I came home, but my manager took more interest in breaking land for hay and green corn crops than in my hobby. . . . . I tried in 1914 to engage a man who would be capable of carrying out experiments for me in the Islands but without success; what is needed is a good nurseryman, one accustomed to raising trees from seed, and a man who would know when and how to transplant. . . . . There are no men in the Islands with knowledge of the craft, and again it is so long before there are any tangible results. . . . Ground must be prepared by ploughing and the rubbish must be cleared off. The soil in the best ground is a mass of roots, and to insure some measure of success the experiments should be made on a fairly large scale, ploughing and cleaning the ground is a laborious process and people in the Falklands are hardly in a position to sink the required capital. I don't think there would be much trouble over wind-breaks if suitable ground were selected in the valleys, but I doubt if any good results would be obtained by planting on the ridges where hard clay is generally found 6 or 9 in. below the surface. Gorse

* Carl Skottsberg, A Botanical Survey of the Falkland Islands, 1907–1909.

makes a good wind-break and grows freely, but the bushes I mentioned as coming from Tierra del Fuego would be better, and there is a kind of Poplar whose leaf on the underside is a silvery colour; this grows like a weed. The original plant was in Government House Gardens and I obtained a slip or two in Governor Kerr's time. Willows grow freely."

In January, 1911, suggestions for tree planting in the Falklands were made by Kew on behalf of Mr. E. P. Cotton, and within the last few months advice has again been sought.

From the foregoing notes it is plain that with the exception of the work carried out by Mr. Blake no real effort has been made to establish trees in the Falkland Islands under forest conditions and that the trees planted in gardens have apparently survived only so long as they were well sheltered. Therefore, although many of the introduced trees seem to have disappeared within a few years, it has yet to be found out whether trees planted in large enough blocks to afford one another shelter will succeed. With this in view the following suggestions have been made.

In any attempt that may be made to establish trees in the Islands, the authorities must be prepared for a good deal of experimental work and many disappointments before they can entertain an idea of establishing a successful forest area or be certain of the impossibility of such an object. Unfortunately there are no native trees to guide them in the selection of likely subjects for forest work, whilst soil and climate are very indifferent. Wind and the comparative scarcity of natural shelter appear to be the chief difficulties standing in the way of any attempt to establish trees in the Islands. In addition, cold and wet soil, often of a sour, peaty nature, and a comparatively low maximum temperature, all of which are more or less detrimental to tree growth, have to be faced. On the other hand, the absence of severe frost and the fact that several European trees have grown well until they reached the top of their shelter are favourable signs, and it is an encouraging fact that the European Gorse or Furze attains its maximum height in the Islands and that a Poplar and Willows thrive. This proves that, given shelter, the soil conditions can be adapted for the successful growth of certain exotic trees and in any future operations that may be contemplated provision should be made for planting the trees in large blocks, for the greater the depth of a plantation the taller the trees are likely to grow. In small woods planted in exposed places, practically all the trees are exposed and stunted, whereas in a wider area each succeeding rank of trees grows a little taller than the one immediately in front until finally well-developed specimens are obtained. For experimental purposes at least 50 acres in not more than three areas should be planted, provision being made for their proper upkeep for at least ten years. The most suitable position would probably be found in the valleys of the West Island. At the end of ten years it would be possible to form a fairly accurate idea as to whether tree planting upon a more extended scale was justifiable and likely to be of benefit

to the islanders, or whether the project was doomed to failure. In any case, if proper records were kept, the experiment would be of considerable value in the event of future operations of the same nature being suggested.

In order that any experiments that may be contemplated should not fail through want of proper attention to details, it is desirable that an intelligent man should be appointed who would be able to give his whole time to the work and be able to keep proper records. A young man with practical knowledge of forest work at a high elevation in the West Highlands of Scotland or on the mountains of Wales would be desirable, more particularly a man who was capable of training youths in all kinds of practical work, *i.e.*, seed sowing, nursery planting, permanent planting, preparing ground, fencing, draining, road-making, &c.

The provision of shelter appears to be the key to successful tree planting in the Falklands for, given shelter from wind, other conditions of climate and soil can be met. The only native plant that can be depended upon for shelter is *Veronica elliptica*, and the maximum height of that plant is barely 7 ft. For shelter purposes the height may be taken as from 4 to 5 ft. There are other native shrubby plants growing from 1 to 4 ft. high which may also be of some value for certain places. Fortunately the common Gorse grows well in the Islands. It is a good shelter plant and in addition to being used for hedges, seed might be sown over land to be planted with trees two or three years in advance of the trees. Land that is already covered with Gorse could be dealt with immediately. In addition, various subjects such as those mentioned by Mr. Blake might be procured from Tierra del Fuego. Round the outskirts of a plantation a belt of Gorse or Veronica as dense as possible should be formed. The accompanying photograph gives a good idea of the value of Gorse as a hedge plant for the Falklands. The outer belt for a plantation should be 6 or 8 ft. wide, or perhaps a little wider on the side of the prevailing wind. Behind this the shelter plants should be thin enough to allow of trees being planted 3 ft. apart. This distance is approximate, and it may be found advisable to have small groups of shelter plants with young trees in between or even parallel, narrow hedges 12 to 20 ft. apart. In no case, however, ought the shelter plants to be allowed to form large gaps amongst the trees. They are simply to protect the young trees for a few years, afterwards they must provide their own shelter, which they are best able to do by forming a dense mass of branches. It is not advisable to form a straight boundary line to a plantation, an undulating outline often forming a better wind-break in addition to presenting a better appearance.

In places where the soil is naturally of a loamy or sandy nature and is naturally drained, it can be prepared for planting with little trouble. If clear of bushes it may be ploughed or turned over by some other means, but when bushes exist the intervening spaces should be dug, removing at the same time any plants not required for shelter. When the ground is naturally wet, open drains, 15 in. wide and $1\frac{1}{2}$ to 2 ft. deep.

or wider and deeper if necessary, should be dug at intervals of from 12 to 20 ft., parallel with the natural slope of the land. In the case of wet and sour peat, drains should be opened about 6 ft. apart. They should be 15 in. wide and 15 to 18 in. deep, the peat being removed in large blocks and laid upside down on the margins of the drains to sweeten; occasional wider and deeper drains may be required. From 4 to 6 months afterwards, a young tree may be planted in the centre of each turf, taking care to pulverize the soil well as it is replaced about the roots. A little basic slag may be mixed with the soil at the time. By the time the young trees have filled the upturned and inverted sod with roots, the upper or drained portion of the peat bed will have become sufficiently sweetened by drainage and the admission of air for the roots to enter. When cutting drains and arranging planting positions in this way the men should work in pairs, otherwise, for convenience, they are inclined to cut the peat out in small sections which are unsuitable for the subsequent reception of plants. As a rule the turves are so arranged that the plants can be placed about 3 ft. apart. Vacancies caused by the death of young trees must be filled at an early opportunity. Should a hard pan of clay or gravel occur a little below the surface of the ground it must be broken up during the preparatory work.

All ground that is to be planted with trees must be provided with a sheep- and rabbit-proof fence, otherwise the young trees will probably be eaten off soon after they are planted.

An acre or two of ground in a favourably situated part of the area selected for planting should be set apart for a nursery. The ground must be trenched, manured, and properly cultivated. Any ground not required for immediate use might be planted with potatoes, turnips or some other crop. Shelter must be provided by a wall or by a good hedge of Veronica, Gorse or some other subject; one or two cross hedges would also be an advantage. The seeds should be sown in beds 4 ft. wide and any convenient length, separated by paths 15 in. wide, advantage being taken of the earliest dry days of spring to carry out the work. When the young plants are about 3 in. high they must be transplanted into nursery lines 12 in. apart and 2 to 4 in. between the plants. In this position they will remain until 6 or 9 in. high. Any trees that can be increased by cuttings, such as Willows or Poplars, may be started in the nursery or in the places the trees are to occupy. Stock plants ought, however, to be kept for cuttings so that trees in permanent positions could be left untouched.

When the young trees are from 6-9 in. high they should be placed in permanent positions and spaced from 3-4 ft. apart, according to the nature of the soil and the species. They must be lifted carefully so that all the roots are preserved, and during planting, if the ground has not been previously worked, care must be taken to make the holes wide enough to allow the roots to spread out to their full extent. Care must also be taken to keep the upper roots near the surface of the soil. Early autumn and spring are the best times for planting trees. Probably autumn

will be the most satisfactory time for the Falklands as the winds are stated to be at the worst in spring

On account of the peculiar conditions prevailing in the Islands it is probable that evergreen coniferous trees will prove more successful than deciduous, broad-leaved trees, and for general planting, particularly on the wetter ground, it is likely that the most appropriate tree of all will be *Picea sitchensis*, followed by *Picea Engelmanni* and *Picea alba*. The two former are natives of Western N. America and the latter of Eastern N. America. For well-drained land *Pinus Banksiana* from N. America, *P. contorta* var. *Murrayana* from Western N. America and the European *Pinus Cembra* and *Pinus sylvestris* might be tried. As a shelter tree for the outskirts of plantations a trial should be made of the Austrian Pine (*Pinus Laricio* var. *nigricans*). This is an excellent shelter tree although its timber is not of good quality. Other Conifers such as *Cupressus nootkatensis*, *Cupressus macrocarpa*, *Thuya plicata*, and *Araucaria imbricata* are worth a trial.

Amongst broad-leaved trees the most likely ones to succeed are Birches, Alders, Willows, Poplars and the Antarctic Beeches. Of the Birches the form of *Betula alba*, known as *pubescens*, and the N. American *B. occidentalis* and *B. papyrifera* should be tried. The most suitable Alders are *Alnus glutinosa*, and *A. incana*, both European trees adapted for wet ground. Of the tree Willows *Salix alba*, *S. coerulea*, *S. fragilis* and *S. viridis* are suitable, whilst of basket-making Willows *S. triandra*, *S. viminalis*, *S. purpurea* and *S. rubra* might be tried. Poplars should be represented by *P. Eugenei*, *P. serotina*, *P. canescens*, and *P. trichocarpa*. The Sycamore, *Acer Pseudoplatanus*, and the Antarctic Beeches from Tierra del Fuego are also worth attention. For shelter and ornament the following small trees and shrubs may be tried. *Ligustrum ovalifolium*, *L. vulgare*, *Tamarix* in variety, *Sambucus nigra*, the stronger-growing New Zealand Veronicas, *Hippophae rhamnoides*, *Escallonia macrantha*, *Pyrus Aucuparia*, *P. Aria*, *P. intermedia*, *Berberis Darwinii*, *B. Aquifolium* *Rhododendron ponticum*, *R. catawbiense*, *Olearia Haastii*, *Calluna vulgaris*, and *Cytisus scoparius*.

To conduct anything like an exhaustive experiment with trees planted under forest conditions will entail some considerable expense, but that cannot be avoided, and in a letter to Kew, dated 14th April, 1919, Mr. Blake says that he is willing to undertake the preparation of all the land required for such an experiment providing an expert man is provided to control the work.

It is to be hoped that the Government of the Falkland Islands may find itself in a position to accept Mr. Blake's interesting offer, as the proper preparation of the ground, which is a matter of considerable expense, is of prime importance, and such an experiment should certainly be made.

Tussock Grass or Tussac Grass.

Poa flabellata, Hook. f., the Tussock or Tussac Grass, is one of the most interesting plants of the Falkland Islands. It is

a perennial and forms large clumps or masses rising to a height of 7 ft. with long, arching leaves which possess valuable feeding properties and are greedily eaten by horses, cattle and sheep. The bases of the leaves, stem and rootstock are sweet, with a nutty flavour, and offer such a temptation to horses and cattle that when allowed free access to the plants they almost invariably kill them by eating them to the ground line. Sections of the stems cut into small pieces and prepared in various ways are also eaten by the inhabitants, whilst one of the early Governors of the Islands records that two deserters from an American ship kept themselves alive for 14 months by eating the stems.

Attention was originally directed to the plant by Col. Moody, the first Lieut.-Governor of the Falklands, in 1842, in a despatch to Lord Stanley at the Colonial Office. During the same year the Antarctic Expedition under Sir James Clark Ross wintered in the Islands and Dr. Hooker paid a good deal of attention to the grass, sending home a description and apparently seeds to his father, Sir William Hooker, at Kew, who, in turn, read a paper on the plant before the Geological Society in November, 1842. From that time onwards for several years Governor Moody continued to direct the attention of the Colonial Office to the value of the grass as a fodder plant and strongly recommended on several occasions that experiments should be made with it on the exposed shores of the islands on the coast of Scotland, suggesting that one of the small islands of the Orkneys, such as Hunda, should be given up for the purpose. He further recommended that a man should be sent out to study the plant and collect seeds.

In 1844 Governor Moody reported to Lord Stanley that a settler, Jergen Christian Detleff, had a parcel of 6 lbs. of Tussac seed for sale, which he was desirous of sending to England and for which he expected not less than £2 10s. a pound, but for a large quantity he would probably accept a less price per pound. In this report the Governor very strongly recommended that the grass should be given an extensive trial in Britain, and on 1st February, 1884, in a letter to Sir W. Hooker, he advised the despatch of a quantity of seed for Kew, enclosed with a larger amount to Lord Stanley at the Colonial Office, with a quantity from a settler on speculation for sale. This seed appears to have been widely distributed, and there is evidence that within a few months plants were growing at Kew, Glasnevin, Clonbrenny in County Meath and in the Island of Lewis. It is only in the latter place, however, that there is any reason to suppose that it was planted as a farm crop. The seed was sent to Lewis by Mr. (afterwards Sir James) Matheson, then a Member of Parliament, and the cultivation of the grass was undertaken by Mr. Scobie. Writing to Mr. Matheson in 1849, Mr. Scobie reported "The seeds which you sent me in 1844 were sown the following spring in various parts of the islands, viz., Coll, Holm, Linshader, Golson, &c.; of all these the two former were the only places where this valuable grass appeared, and of these two Holm was the most successful and vigorous, being sown in a square plot of deep, brown moss of

medium dryness close to the sea." About this time Lewis-grown seed appears to have germinated fairly well and all spare seed was sent to Messrs. Lawson of Edinburgh. The only sample in the Kew Museums was procured from that firm and was from the 1850 crop. Some years later when seeds were required to send to Australia there was a difficulty in obtaining them fully developed or fertile. On several occasions between 1850 and 1888 plants were sent from Stornoway to Kew for distribution to other places. In 1888, however, the farm-grown plants had disappeared from Lewis owing to the apathy of the farmers and their objection to planting a grass that required cultivation and could only be fed to stock in a cut state, through the animals killing the plant when allowed to graze upon land where it was planted. The plants obtained in 1888 were from the private garden of Sir James Matheson at Stornoway, and some were sent to Prof. Hartog at Cork, who reported the following year that the grass was doing well on drained bog at Dunmanway. In 1889 Prof. Hartog received seeds direct from the Falkland Islands which seem to have grown well in Ireland. He sent seeds to Kew and other places which do not appear to have caused later comment. As a matter of fact the grass does not grow well at Kew; it never becomes vigorous and soon dies out. It apparently must have a comparatively cool climate and a peaty soil. As Mr. Scobie attained a greater degree of success than any other planter in Britain so far as records show, it may be advisable to quote his remarks regarding the behaviour of the grass in Lewis. He says: "The seed was sown in a square plot of deep brown moss of medium dryness close to the sea. The moss, scarcely yielding anything previous to its being turned over and enclosed, was delved and cut into small pieces with the spade, and the seeds sprinkled in and roughly covered with a rake, and trampled at the same time with the feet. The second year the stools were almost as strong as the third, though it is allowed this grass only attains maturity the third year, it cast seed the second and third years. Three acres were delved over, of the same deep moss, in spring, 1847, to the depth of 12 in., and after it was packed with a hoe, a sprinkling of guano applied, and single plants dibbled in 3 ft. 4 in. apart. The whole of this prepared moss is drained 3 ft. deep and 20 ft. apart, being moss drains. . . . . I think the moss for the Tussac should be delved over in January, and a light spading of moss thrown over the surface, out of the bottom of the trench, to keep out the sun from drying-up the moss too much. February March and April are most advisable for planting, May and June having proved too late and dry. Plants supplied with seaweed manure are greener in the leaf and thriving better than the rest. Some failure occurred from wet rising from below in the moss, and also from imperfect drainage, and from drought, the peat being liable to become very hard in summer. Seaweed spread over the surface of the ground in summer is an advantage."

According to a Kew record dated 1877,* the plants on Sir

* Kew Report, 1877, p. 21.

James Matheson's land in the Hebrides had for some time suffered from the attacks of a coleopterous larva. By the same note we find that Sir Joseph Hooker had by that time modified his views regarding the general value of the grass, for he says: "I have expressed my doubts as to the plant being really adapted for pasture purposes. The Tussocks are only formed slowly, and would be soon destroyed by cattle, and the plant consequently exterminated."

Within the last few years recommendations have been made that the grass should be widely planted in the colder and more exposed parts of Britain, but before undertaking experiments, intending cultivators would be well advised to take advantage of the experience gained from previous experiments, and to remember that the plant can only be grown successfully in positions near the sea, and on properly drained and cultivated ground. Moreover, the leaves must be cut and fed to cattle, for if cattle are allowed free access to the plants they are invariably killed by the animals eating the bases. It must also be remembered that the grass has not come up to expectations in the past, either here or in the Falklands, where in 1844 it was referred to as the Golden Glory of the Falkland Islands.*

There appears to have been some disagreement as to the date of introduction of Tussock Grass into the British Isles. The Ross Expedition has been credited with its introduction in 1842, and another date is given as 1844. The matter appears to be settled in "Life and Letters of Sir J. D. Hooker," i. p. 130. Answering a letter to Sir J. Ross in November, 1844, Sir Joseph wrote: "I am delighted to hear that some of the old Tussac vegetated, as everyone has said that our expedition seed all failed. It is quite a triumph to me, I can assure you, as now the expedition was the first to introduce the grass. I have 11 plants in my bedroom, growing very slowly, and there are a great many in the garden." This evidence is, however, discredited by a later letter written to Sir J. Ross on 1st September, 1845, for Sir Joseph wrote: "your excellent brother's plant of Tussac flowered with us and turned out to be the British *Dactylis glomerata*, to our shame and confusion at Kew. . . . The fact is that we have only lately procured seeds and raised young plants of the true Tussac." This suggests that the first plants were raised from seeds sent by Governor Moody in 1844.

For an exhaustive account of the introduction to, and experimental planting of Tussock Grass in Britain, the Journal of the Royal Agricultural Society, 1842-1850, should be consulted.

Explanation of Plates.

Plate IV.—The homestead surrounded by Gorse hedges some 6 ft. or 8 ft. high. The crop being cut is green oats for hay. The house stands about 80 ft. above sea level. All the land under oats is suitable for tree-growing. The hill in the distance rises to 2000 ft.

* A Report on the capabilities of the Falkland Islands.

Plate V., Fig. 1.—A crop of oats with potatoes in the foreground close to the fence.

Fig. 2.—The same batch of oats seen in Fig. 1. The fence and potatoes being on the right of the photograph. The ground is all ploughed down to the beach.

XII.—DECADES KEWENSES

Plantarum Novarum in Herbario Horti Regii Conservatarum.

DECADES XCII. & XCIII.

911. Aconitum funiculare, *Stapf* [Ranunculaceæ-Helleboreæ]; inter species sectionis *Napelli* tuberibus bornotinis pluribus funicularibus insigne.

Tubera (in specimine unico viso) 5; unum annotinum, cætera bornotina, omnia cylindrica, basin versus attenuata, tota longitudine radices secundarias circiter 1 cm. distantes emittens, 3-9 cm. longa, 2-5 mm. diametro, viva pallide fusca, fractura nitens amylacea, sapore tolerabili; cambium cylindrum centrale tenuissimum formans. *Gemmæ* tuberum breviter conicæ, 3-5 mm. altæ. *Caulis* erectus, 4-5 dm. altus, gracilis, pilis reversis crispo-pubescens vel superne tomentellus. *Folia* infrafloralia sub anthesi 2, cætera 4 ramulos uniflores (vel ei mavis pedicellos) suffulgentia, seniem reducta, illa ambitu reniformia, circiter 3 cm. alta, 5 cm. lata, ima basi 5-pedato-partita, carnosula, utrinque sparse minute pilosula, segmentis cuneatis interioribus 3-lobatis extimis 2-lobatis, lobis late linearibus vel lineari-lanceolatis acutis; petiolus infimus 5 cm. longus, folii floralis infimi brevissimus, omnes parce minute pubescentes. *Racemus* pauciflorus; pedicelli distantes, 10-6 cm. longi, pube eadem ac caulis indui, medio 2-bracteolati, bracteolis integris linearelanceolatis, pedicellis superioribus ad 1·5 cm. longis. *Sepala* pubescentia, deciduа, summum galeiforme; galea erecta, apice depressa et in rostrum breve subacutum horizontaliter producta, ad 2 cm. alta, superne 1 cm. lata (a latere visa) lilacina, rostro virescente; sepala lateralia oblique rotundato-obovata, vix nervulata, 1·3-1·4 cm. diametro cum galea contigua, superne pallide, inferne magis saturate lilacina, supra medium viridimaculata; sepala inferiora elliptica, subacuta, circiter 1 cm. longa, violascentia vel virescentia. *Nectariorum* stipes in galea recte ascendentes, apice prorsus curvati, 1·4-1·8 cm. longi, summo parce pilosuli, mitella latissima suborbiculari dorso vix gibbosa, glandola terminali lata viridi vel violacea, labio lato integro obtusissimo recurvo albido. *Filamenta* glabra, a medio basin versus alata pallida, supra intense cærulea. *Carpella* 5, subcontigua, pubescentia, apice abrupte contracta; stipi 2 mm. longi.

Bhotan, Cooper 3586.

The affinity of this new Aconite lies probably with *A. Hookeri*, Stapf, with which it has much in common, as to the general structure of the tubers, the facies of the leaves and the inflorescence

and the shape of the nectaries, but it differs from it in the absence of the characteristic hypogaeous portion of the stem and the remarkable rope-like tubers, which are unique in the section Napellus. The plant was raised at Kew from seed collected by Mr. Cooper for Messrs. Bees, Limited.

912. Indigofera Barberi, *Gamble* [Leguminosae-Galegeae]; *I. trifoliatae*, L. affinis, foliolo terminali petiolulato, legumine toruloso ad suturarum latera haud alato 2-4 spermo differt.

Suffrutex parvus, ramosus, ramis ascendentibus appresse griseo-pubescentibus strictis. *Folia* 3-foliolata, foliolis obovatis mucronatis appresse villosis subtus glandulosis, 1·5-3·5 cm. longis ad 2 cm. latis, terminali longiore; petiolus communis 1-2 cm. longus; petiolulus terminalis ad 1 cm. longus, laterales brevissimi; stipulae setaceae, caducae. *Flores* minuti, in racemos axillares 7-10 mm. longos multifloros aggregati. *Calyx* circa 1 mm. longus, dentibus 5 aequalibus subulatis villosis. *Corolla* exserta; vexillum ovatum, sessile; alae oblongae, basi acutae, vix in unguem contractae; carinae petala obtusa, falcata, basi calcare acuto munita. *Legumen* lineare, torulosum, ad 15 mm. longum, appresse albo-villosum, deflexum, suturis incrassatis, apice longe acuminatum, acumine recurvo, seminibus 2-4.

S. India. Cuddapah hills, *Beddome*; Melpat, S. Arcot, *C.A. Barber* 1076 (Sept. 1899); Shevaroy hills, Salem, *Bourne* 869 (October 1897).

I have long hesitated about this species. I agree with Dr. Barber in considering it as coming between *I. trifoliata*, L. and *I. trita*, L.f., and think it best to describe it as new, for I cannot consider it even as a varietv of either.

913. Erythrina mysorensis, *Gamble* [Leguminosae-Phaseoleae-Erythrineae]; *E. strictae*, Roxb., affinis, floribus minoribus, corollae alis et carina aequilongis circa 12 mm. longis, staminibus diadelphis, foliolis late ovatis abrupte acuminatis subcoriaceis differt.

Arbor, ramulis inermibus (an semper?) *Folia* trifoliolata petiolo communi 10 cm. longo, petiolulis 0·75 cm. longis, stipellis verrucosis; foliola subcoriacea, late ovata, apice abrupte acuminata, terminale 12 cm. longum 9 cm. latum, lateralia 10 cm. longa 7 cm. lata nervis utrinque 6 conspicuis quorum 2 inferiores e basi oriuntur. *Racemi* axillares, 12-15 cm. longi, floribus apicem versus fasciculatis vix 3 cm. longis coccineis. *Calyx* spathaceus, ad dimidiam partem fissus, supra minute dentatus. *Corolla* exserta; vexillum obovato-oblongum, emarginatum, 3 cm. longum; alae obovatae, 12 mm. longae; carinae petalae liberae, alis aequilongae, late falcatae. *Stamina* diadelpha, 9 et 1. *Ovarium* lineare, villosum, stylo subulato glabro. *Legumen* ignotum.

S. India. Mysore; Chickenalli, 900 m., *A. Meebold* 9728 (Nov. 1908; Herb. Calc.).

Although this is the only specimen apparently known, I have thought it best after much consideration to describe it, as the

flowers differ so greatly from those of any other species. It resembles *E. indica* in having the wings and keel equal but the flowers are very much smaller and the leaves are different.

914. Smithia Venkobarowii, *Gamble* [Leguminosae-Hedysareae]; *S. blandae*, Wall., affinis, sed floribus non paniculatis et calyce glabro margine solum breviter ciliato differt; inflorescentia subcapitata, pedunculo gracili et foliolis ad 2·5 cm. longis insignis.

Herba gracilis, suberecta vel prostrata, ramulis patule strigosis. *Folia* paripinnata, circa 3 cm. longa, foliolis 4-jugis, petiolo communi circa 15 mm. longo strigoso; foliola oblonga, glabra, obtusa, 2·5 cm. longa, 7-8 mm. lata; stipulae lineari-lanceolatae, striatae. *Flores* in racemos subcapitatos pedunculatos axillares congesti; pedunculi 2-3 ex quaque axilla, 2-4 cm. longi, graciles; bracteae paleaceae, glabrae; bracteolae subfalcatae, glabrae, aliquando paucidentatae. *Calyx* ad basim fissus, margine breviter ciliatus; labium superius latum, emarginatum, inferius 3-lobum. *Corolla* eximie lutea, exserta; vexillum orbiculatum, emarginatum; alae falcatae, obtusae, basi calcaratae; carinae petala angusta, curvata, apice acuta. *Ovarium* sessile, circa 6-ovulatum; stylus filiformis. *Lomenti* articuli 3-6, compressi, circa 1·5 mm. diametro, reticulati, margine plani.

S. India. Travancore; hills at Peermerd. *K. Venkoba Row* 3799 (Oct. 1916).

915. Desmodium wynaadense, *Bedd. MS. ex Gamble* [Leguminosae-Hedysareae]; *D. rufescenti*, DC., affinis, foliolis longioribus lanceolatis acutis, pedicellis longioribus filiformibus, leguminibus latioribus curvatis fere glabris conspicue reticulatis differt.

Suffrutex erectus, ad 3 m. altus, caule et ramulis et racemorum rhachi molliter ferrugineo-pubescentibus. *Folia* trifoliolata, pedunculo communi 1·5 cm. longo; stipulae basi lanceolatae, longe setaceo-acuminatae; stipellae etiam longe setaceae; foliola lanceolata vel oblongo-lanceolata, apice acuta vel aliquando paullo obtusa, basi attenuata, supra fere glabra, subtus pubescentia, 5-7 cm. longa, 2-2·5 cm. lata, ultimum paullo longius, nervis primariis circa 9 conspicuis, nervulis transversis multis subparallelis. *Racemi* terminales et axillares, elongati, ad 20 cm. longi, floribus sparsis singulis vel binis; bracteae lanceolatae, setaceo-acuminatae, villosae, striatae, cito deciduae, 5-6 mm. longae; bracteolae 0; pedicelli filiformes, patentes vel deflexi, 10-12 mm. longi. *Calycis* tubus brevis, dentibus hirsutis acuminatis, labio superiore bifido, inferiore longiore 4 mm. longo. *Corolla* rosea, exserta; vexillum obovatum, retusum, 6 mm. longum; alae oblongae, latae, paullo breviores; carinae petala late falcata, medio calcarata, cum alis connata. *Stamina* diadelpha, (9 et 1) antheris oblongis aequalibus. *Ovarium* sessile, lineare, pubescens, stylo geniculato glabro, stigmate parvo capitato. *Legumen* curvatum, deflexum, compressum, ad 4 cm. longum, articulis 5-8 facile secedentibus planis conspicue reticulatis

fere glabris ad suturam ventralem paullo curvatis maturitate dehiscentibus 3-4 mm. latis. *Semina* castanea, laevia, reniformia, 2 mm. longa.

S. India. Nilgiri hills; Carcoor Ghat (March 1880), *Beddome*; Nellialum, 670 m., *Gamble* 18404 (1886); Pundalar, *Lawson* (Nov. 1888); Anamalai hills, Attakatti, 980 m., *C. E. C. Fischer* 3279 (1912); Travancore hills, Arienkara, *M. Rama Row* (1912); Udambanshola, 1525 m., *Meebold* 13204 (1910).

916. Vigna Bourneae, *Gamble* [Leguminosae-Phaseoleae]; nulli aliae peraffinis, ad *V. pilosam*, Baker, calyce et corolla accedit, sed multo major, ramulis crassis ut foliis dense ferrugineo-velutinis, pedunculis longis eximie nodosis, stipulis conspicuis peltatis oblongo-lanceolatis.

Suffrutex scandens, ramulis crassis pilis ferrugineis retrorsis tectis. *Folia* petiolo ad 8 cm. longo; foliola ovata, acuminata, ferrugineo-villosa, ad 8 cm. longa, 5·5 cm. lata; ultimum saepe basi deltoideum, petiolulo circa 1 cm. longo, stipellis subulatis; lateralia basi inaequalia breviter petiolulata, etiam stipellata; nervi utrinque circa 5, 2 infimi e basi orti; stipulae peltatae, oblongo-lanceolatae, 1-1·5 cm. longae. *Racemi* axillares, pedunculis ad 20 cm. longis crassis, rhachi 6 cm. longa valde nodosa; bracteae et bracteolae oblongo-lanceolatae, hirsutae, striatae, circa 7 mm. longae. *Calyx* campanulatus, 5 mm. longus, lobis brevibus, 2 superioribus obtusis connatis. *Corolla* exserta, 1-1·5 cm. longa; vexillum latum, basi auriculatum; alae latae, obtusae, basi semi-sagittatae; carinae petala curvata, rostrata, basi breviter unguiculata. *Ovarium* villosum; stylus apice sub stigmate obliquo barbatus. *Legumen* planum, primo dense villosum, deinde glabrescens, apice subobtusum, 5-6 cm. longum. *Semina* 10-12, quadrata, 2-3 mm. longa.

S. India. Pulney Hills: Madura District; on Poombarai riverside and Kodakanal Ghat, *Sir A. G. and Lady Bourne* 1291, 2005 (1898-99).

917. Rosa (Cinnamomea) Saundersiae, *Rolfe* [Rosaceae]; affinis *R. macrophyllae*, Lindl., aculeis gracilibus, foliis tenuioribus et floribus minoribus albis differt.

Frutex ramosus, ramulis ad basin foliorum aculeis binis gracilibus et rectis instructi, caeterum glabris. *Folia* 3-7 cm. longa, 7-9-foliolata; rhachis puberula, sparse aculeolata, aculeis rectis et gracilibus; foliola subsessilia, tenuia, elliptica, subobtusa, regulariter inciso-dentata, utrinque glaucescentia, subtus in venis puberula, 1·5-3 cm. longa, 0·6-1·2 cm. lata; stipulae adnatae, oblongae, subacutae, minute ciliato-glandulosae, circiter 1 cm. longae. *Flores* 3-3·5 cm. diametro, albi, in ramulis brevibus solitarii vel pauci. *Pedunculi* 2-2·5 cm. longi, puberuli et glandulosi. *Receptaculum* anguste ellipsoideum, 0·6 cm. longum, copiose glandulosum. *Calycis* lobi ovato-lanceolati, caudato-acuminati, patentes, circiter 2 cm. longi, apice interdum subfoliacei, intus canescenti-tomentosi, extus tomentosi et glandulosi. *Petala* obovata, 1·5 cm. longa, alba. *Filamenta*

glabra, 2-3 mm. longa. *Carpella* villosa; styli 3 mm. longi. *Fructus* ellipsoideus, coccineus, 1·5 cm. longus.

N.W. India. Murree, on lower forest road and in the gullies, *Miss E. M. Saunders*, June-July, 1915.

This is recorded by Miss Saunders as an erect shrub with long, straight thorns and white petals. With the general habit and characters of *R. macrophylla*, Lindl., it is more comparable with *R. Fedtschenkoana*, Regel (as shown in Bot. Mag. t. 7770), in the shape and texture of the leaflets and colour of the flowers. It may also be compared with the Western Chinese *R. Muriclae*, Rehder & Wils., though that has more coriaceous and less dentate leaflets and longer pedicels. Nothing like it has been found among Asiatic Roses, and as comparatively little is known about the flora of the Murree Hills, which reach an altitude of 7000 to 8000 ft., it is here described as new. The materials sent include both flowering and fruiting specimens.

918. Bruguiera Hainesii, *C. G. Rogers* [Rhizophoraceae-Rhizophoreae]; species *B. gymnorhizae*, Lam., *B. eriopetalae*, W. & A., *B. caryophylloidei*, Blume, quodammodo affinis, ab omnibus trunci magnitudine corticis charactere facile distinguitur; ab illis duabus pedunculis 2-floris, sepalis brevioribus,* petalis multo brevioribus, petalorum lobis prope apices extus leviter pilosis, ab hac floribus multo majoribus, calycis tubo cylindrico-obconico neque ellipsoideo sepalis erectis differt.

Arbor magna ad 24 m. alta et 70 cm. trunci diametro, cortice rugoso. *Folia* anguste-elliptica, utrinque cuneata, basi in petiolum 2·5-4 cm. longum angustata, 9-13 cm. longa, 4-7 cm. lata. Pedunculi breves, 7-13 mm. longi, 2-flori; pedicelli 6-8 mm. longi. *Flores* 2·2-2·5 cm. longi,* calycis tubo sepalis aequali vel longiore leviter 10-angulato nunquam jugis prominulis instructo. *Sepala* lineari-subulata 10. *Petala* 2-loba, 7-8 mm. longa, marginibus inferne villosis, versus loborum apices extus leviter pilosa, loborum apice 2-3 setis cum una seta longiore in fissura instructa.

Burma. Mergui, in Tidal Forests, *Rogers* 456 M.

This new species differs from both *Bruguiera gymnorhiza* and and *B. eriopetala* in the size of the tree and in the bark. Both these species are the same size. They attain a height of 60-80 ft. with a clean bole of from 40-60 ft., with a girth at breast height over the bark of from 40 to 54 in. The new species grows to a height of 100 ft., with a clean bole of 75 ft., and a much rougher somewhat tesselated bark, and a girth of 60 to 72 in. It is a distinctly taller and larger tree.

The tree was not uncommon in the Panadaung Reserve (immediately to the south of the Bokgyi creek, about 30 miles up the coast (North) of Mergui Civil Station) and will, I feel confident, be found to be fairly common throughout the Mergui District. The specimens were collected on the 2nd January, 1919. We had considerable difficulty in finding flowers with petals then. The ground on which the trees stood was only inundated for a few hours at fairly high spring tides.

* Measurements of the flowers are taken after opening and before the fall of the petals, after which the size increases as in other species.

919. Sonerila pulneyensis, *Gamble* [Melastomaceae-Sonerileae]; nulli aliae peraffinis, ramulis repentibus radicantibus, foliis carnosis ovatis, calycis tubo fructifero campanulato laevi insignis.

Frutex carnosus, humilis, ramulis repentibus radicantibus glabris. *Folia* carnosa, ovata, mucronato-serrata, glabra, apice acuta, basi in petiolum attenuata, 2-5 cm. longa, 1-3 cm. lata, nervis circa 5 gracilibus ex apice petioli ortis, aliis utrinque circa 5-6 obscuris, omnibus apicem versus curvatis; petiolus 5-15 mm. longus. *Cymae* axillares 2-5-florae, pedunculo communi 3-4 cm. longo; pedicelli 1 cm. longi. *Flores* adhuc ignoti. *Capsula* campanulata, 7-10 mm. longa, pallida, laevis et lucens. *Semina* 1 mm. longa, laevia, raphe conspicua circumdata.

South India. Pulney hills; in the Pambar ravine, June, 1899, *Sir A. and Lady Bourne* 1341.

Although the flowers have not yet been collected, I have thought it right to describe this plant from the excellent fruiting specimens in Herb. Kew, so as to include it in the "Madras Flora."

920. Memecylon flavescens, *Gamble* [Melastomaceae-Memecyleae]; species insignis foliis parvis oblanceolatis flavescentibus, *M. Lushingtonii*, Gamble, plus minus affinis, floribus in cymis parvis in tuberculis parvis et bracteolis ovato-lanceolatis differt.

Arbor parva, ramulis nodosis griseis gracilibus, ultimis tetragonis. *Folia* coriacea, oblanceolata vel spathulata, apice rotundata vel raro subacuta, basi cuneata, 3-5 cm. longa, 1-2·5 cm. lata, marginibus recurvis, nervis perobscuris, siccitate flava; petiolus circiter 5 mm. longus, laminae marginibus decurrentibus alatus. *Flores* in tuberculis parvis axillaribus vel lateralibus fasciculati; bracteolae ovato-lanceolatae; pedicelli 1-2 mm. longi. *Calycis tubus* supra ovarium campanulatus, lobis 4 rotundatis, disci radiis obscuris. *Petala* pallide caerulea. *Antherae* breves, curvatae. *Styli* filiformes. *Bacca* globosa, subcarnosa, caerulea, 7 mm. diametro.

South India. Kundahs country of Nilgiri hills, about Avalanché and Sispara, 2300-3460 m., in evergreen Shola forest, *Gamble* 14268, 16161, 16168, 20581.

921. Memecylon Lawsoni, *Gamble* [Melastomaceae-Memecyleae]: *M. Heyneano*, Benth., affine, foliis multo minoribus, nervis obscuris, florum fasciculis paucifloris, bracteolis ovatis nec lanceolatis differt.

Frutex erectus, ramulis teretibus griseis. *Folia* lanceolata, acuminata, basi attenuata, 6-10 cm. longa, 2-3 cm. lata, glabra; nervi obscuri, utrinque 6-10 in nervum intramarginalem arcuatum desinentes; petiolus ad 5 mm. longus. *Flores* sessiles, circa 6-10, in tuberculis axillaribus fasciculati; bracteolae ovatae, minimae. *Calycis* tubus campanulatus, vix 2 mm. longus, lobis 4 brevibus obtusis. *Petala* matura desunt, verisimiliter caerulea. *Stamina* brevia, connectivo producto obtuso. *Bacca* immatura, 2-3 mm. diametro.

S. India. South-east Wynaad, *M. A. Lawson* (Nov. 1884).

922. Memecylon Lushingtonii, *Gamble* [Melastomaceae-Memecyleae]; species distincta ramulis gracilibus pallidis ultimis subtetragonis, foliis parvis siccitate non flavescentibus et florum fasciculis perbrevibus paucifloris distincta.

Arbor parva, ramulis nodosis griseis gracilibus, ultimis subtetragonis. *Folia* chartacea elliptica vel elliptico-lanceolata, apice obtusa vel interdum emarginata, basi subcuneata 3-5 cm. longa, 1-2 cm. lata, nervis perobscuris, siccitate viridia; petiolus 2 mm. longus. *Flores* in tuberculis axillaribus vel lateralibus (foliorum delapsorum) fasciculati, fasciculis circiter 5 mm. latis: bracteolae minimae; pedicelli perbreves. *Calycis tubus* supra ovarium patelliformis vix 1 mm. longus, lobis 4 brevibus triangularibus, disci radiis obscuris. *Petala* pallide caerulea. *Antherae* breves, curvatae, filamentis filiformibus. *Styli* filiformes, conspicui. *Bacca* globosa, sicca, flavescens, 5-6 mm. diametro.

South India. Cuddapah District, on Horsleykonda, 1300 m., *Gamble* 15110; Coimbatore District, at Osahatti, *A. W. Lushington;* Nilgiri hills at Coonvor and elsewhere, at 1300-1900 m., *Gamble, Bourne.*

923. Memecylon madgolense, *Gamble* [Melastomaceae-Memecyleae]; species *M. marginato,* Blume (*M. intermedio.* C. B. Clarke in Fl. Br. Ind. ii. 561) affinis, foliis minoribus et praecipue pedunculis et pedicellis brevioribus differt.

Frutex erectus, ramulis teretibus brunneis scabris. *Folia* coriacea, lanceolata, apice obtusa caudato-acuminata, basi acuta, 5-9 cm. longa, 2-4 cm. lata, nervis utrinque circa 8 obscuris in nervum obscurum intramarginalem desinentia, siccitate viridia: petiolus 3-5 mm. longus. *Flores* in cymis parvis paucifloris lateralibus; pedunculi 3-4 mm. longi; pedicelli graciles, breves, fructiferi longiores. *Calycis tubus* patelliformis, 3 mm. diametro, lobis obscuris, disci radiis 16 manifestis. *Petala* nondum visa. *Bacca* (immatura) sicca 4 mm. diametro.

South India. Madgol hills of Vizogapatam at 1000 m., Jan., 1914, *A. W. Lushington.*

The material of this species is very poor, but it seems quite distinct from any other of the South Indian species. It may, however, prove eventually to be the same as the plant mentioned by H. H. Haines in his "List of the Trees, etc., of the Southern Circle, Central Provinces," p. 32, as *Memecylon edule* var. *contractum,* but the specimen of that plant at Kew has much more yellow and shining leaves and almost no peduncles.

924. Memecylon sisparense, *Gamble* [Melastomaceae-Memecyleae]; *M. malabarico,* Cogn., affinis sed major, foliis petiolatis supra non lucidis basi minus cordatis, floribus permultis aggregatis lateralibus vel aliquando axillaribus differt.

Arbor parva vel frutex elatus ramis crassis griseis subscabris, ramulis teretibus. *Folia* coriacea, ovato-oblonga, apice obtusa vel acuta, basi rotundata vel paullo cordata, 6-10 cm. longa, 2·5-4·5 cm. lata, marginibus saepe recurvis, nervis utrinque

circiter 10 irregularibus in nervum intramarginalem arcuatum desinentibus, siccitate olivacea; petiolus crassus, 2-4 mm. longus. *Flores* in tuberculis lateralibus vel aliquando axillaribus fasciculati; fasciculi saepe magni, ad 2 cm. diametro; calyx ruber; corolla insigniter caerulea; bracteolae minimae, ovatae; pedicelli filiformes, 3-4 mm. longi. *Calycis tubus* ultra ovarium campanulatus; lobi 4, subacuti; disci radii haud manifesti. *Petala* angulata. *Styli* filiformes, conspicui. *Bacca* nondum visa.

South India. Nilgiri hills, on Sispara Ghat, 1600 m., June, 1884, *Gamble* 14467; *Wight* (Kew Distrib. 1071); *G. Thomson.*

925. Pimpinella pulneyensis, *Gamble* [Umbelliferae-Ammineae]; *P. Leschenaultii*, DC., affinis, foliis caulinis inferioribus longissime petiolatis, nervis palmatis multis ex insertione petioli ortis, bracteolis umbellularum linearibus, fructu ovato jugis conspicuis differt.

Herba biennis? vel perennis,30-60 cm. alta, radice incrassato fusiformi. *Folia* inferiora caulina orbicularia, cordata, sinu circiter 2 cm. lato, margine serrata, supra ad nervos hispido-pubescentia, subtus glabra, 6 cm. diametro, nervis multis (8-10) ex insertione petioli palmatis, cito ramosis et reticulationem conspicuam formantibus, petiolis 20-30 cm. longis tenuibus pubescentibus, superiora pauca pinnatim decomposita, parva, ultima linearia. *Umbellae* compositae, radiis gracilibus puberulis circiter 10-20 ad 3 cm. longis, bracteis involucrantibus mollibus; umbellulae parvae, bracteolis paucis linearibus persistentibus. *Petala* alba, inflexa, acumine longo acuminato inflexo. *Ovarium* disco pulvinato coronatum, stylis elongatis. *Fructus* ovoideus glaber, stylopodio crasso conico coronatus; juga primaria conspicua 3 a dorso 2 a commissurae margine; vittae in valliculis lateralibus 3 minimae. *Semen* verosimiliter teres ad faciem commissuralem planum.

South India. Bear Shola stream and elsewhere at Kodaikanal, Pulney Hills, May, 1897, June, 1898, *Bourne* 24, 956.

This is the plant described by Mr. P. F. Fyson in his "Flora of the Nilgiri and Pulney Hilltops," p. 172, as the "Pulney form" of *P. Leschenaultii*. He says it frequents damp or cool places near Sholas (evergreen forests), flowering from May to September, while the Nilgiri *P. Leschenaultii* is an erect short-leaved plant of the open downs. The long petioles and the interesting venation of the leaves of *P. pulneyensis* are quite remarkable.

926. Schefflera Bourdillonii, *Gamble* [Araliaceae-Schefflereae]; species distincta, *S. emarginatae*, Harms., quoad foliola parva obovata affinis, sed foliola 5 nec 1-3 et inflorescentia compacta stellato-villosa pedunculo perbrevi.

Frutex epiphyticus, 3-4 m. altus, ramulis lenticellatis et cicatricibus annularibus foliorum delapsorum notatus. *Folia* ad apices ramulorum conferta, digitata, 5-foliolata, petiolo circiter 6 cm. longo basi dilatato glabro; foliola coriacea, obovata, apice obtusa vel emarginata, utrinque glabra 4-5 cm.

longa, 2 cm. lata, margine revoluta, nervis utrinque 2-4 arcuatim junctis et reticulatione conspicua insignibus, petiolulo 1-1·5 cm. longo apice articulato. *Flores* (♀ tantum noti) in racemis umbellarum brevibus subsessilibus stellato-villosis 2-3 cm. longis; pedicelli 1-2 m. longi. *Calycis lobi* 0. *Petala* 5, ovata, acumine inflexo, calyptratim decidua. *Stamina* ignota; staminodia in flore ♀ 5 subulata. *Ovarium* turbinatum, loculis 5, stylis perbrevibus. *Fructus* ignotus.

South India. Near Chimunjee, Travancore, in evergreen forest at 1300 m., April, 1895, *T. F. Bourdillon* 576.

927. Schefflera bengalensis, *Gamble* [Araliaceae-Schefflereae]; *S. Roxburghii*, Gamble, (*Aralia digitata*, Roxb.) affinis, foliolis angustioribus oblongis regulariter nervosis et umbellarum racemis brevioribus differt.

Frutex scandens, ramulis crassis foliorum delapsorum cicatricibus annularibus notatis. *Folia* digitata, foliolis 5 oblongis vel oblongo-lanceolatis glabris 8-20 cm. longis 3-7 cm. latis apice cuspidato-acuminatis basi attenuatis vel subrotundatis; foliorum nervi primarii circiter 8-10, regulares, ad marginem curvati, secundarii et reticulatio satis prominentes; petioli crassi, 10-20 cm. longi, petioluli 2-6 cm. longi; stipulae intrapetiolares rotundatae, crassae. *Flores* sordide rubri, in umbellis in racemorum paniculis terminalibus vix 8-10 cm. longis; rhachis communis crassa, glabra; racemi circiter 10-12 cm. longi; umbellarum pedunculi 1-2 cm. longi; pedicelli breves, 1-2 cm. longi; bracteae in alabastro magnae, orbiculares, floccoso-puberulae, cito deciduae. *Calycis tubus* campanulatus, glaber, truncatus. *Corolla* valvata, calyptratim decidua; lobi ovati, 2 mm. longi. *Ovarium* 5-loculatum. *Fructus* carnosus, siccitate 5-angulatus, glaber. *Heptapleurum venulosum*, Seem.; Fl. Br. Ind. ii. 729, in part.

North India. Mountains of Sikkim at 320-1600 m., *J. D. Hooker*; *C. B. Clarke*; *J. S. Gamble*. Bhutan; *Griffith* (Kew Distrib. 2692); Khasia Hills and Sylhet, *J. D. Hooker and T. Thomson*; *Simons*; Upper Burma; *Smales*.

928. Linociera Parkinsonii, *Hutchinson* [*Oleaceae*-Oleineae]; affinis *L. spicatae*, Ridley, sed foliis basi acute cuneatis chartaceis, pedicellis et calyce puberulo differt.

Ramuli cortice pallide cinereo obtecti, teretes, glabri, laxe foliati. *Folia* oblongo-elliptica, basi cuneata, apice longissime acuminata, obtusissima, 5-12 cm. longa, 2-4 cm. lata, chartacea, supra nitidula, infra opaca, utrinque glabra, costa supra impressa infra valde prominente, nervis lateralibus utrinsecus 6-7 a costa sub angulo latissimo abeuntibus circiter 5 mm. intra marginem junctis infra prominulis; petioli 2-4 mm. longi, glabra. *Flores* axillares, pauci, laxe glomerati; bractae minimae; pedicelli circiter 2 mm. longi, minute puberuli. *Calycis segmenta* 4, anguste triangularia, acuta, 1·5 mm. longa, extra puberula. *Corollae* tubus 2 mm. longus, glaber: segmenta linearia, 4·5 mm. longa, subobtusa, marginibus involutis.

Antherae subsessiles, 1 mm. longae. *Ovarium* glabrum, stylo brevi. *Fructus* juniores anguste et oblique ellipsoidei, basin versus contracti, 1-3 cm. longi.

Andaman Islands. Middle Andaman: Born-lung-ta, up to 60 m., fls. May, 1916, *C. E. Parkinson* 1210; young fr. Nov. 11, 1915; *C. E. Parkinson* 727.

929. Sarcococca vagans, *Stapf* [Buxaceae]: species maxime affinis *S. trinerviae*, Wight, sed habitu vagante laxe ramoso, racemis ♂ laxioribus, floribus ♂ paulo minoribus, ♀ longius pedicellatis differt.

Frutex vagans; juvenilis spinosus (teste English), ramis virgatis saepe flexuosis laevibus glaberrimis cortice pallide viridi tecta. *Folia* 1·25-3 cm. distantia: lamina ovato-vel elliptico-lanceolata vel elliptico-oblonga, basi breviter vel brevissime acuta, apice acute acuminata, 8-13 cm. longa, 4·5-5·5 cm. lata, pergamacea, glaberrima, viridia, vix lucida, triplinervia, nervis lateralibus primariis 5-7 mm. supra basin ortis, secundariis utrinque 2-3 cum primariis arcuatim connectis arcu primo (nervi primarii) ultra medium producto, caeteris multo brevioribus; petiolus 1-1·5 cm. longus. *Racemi* solitarii, erecti, laxiusculi (pro genere), 1-1·3 cm. longi, plerumque ima basi ♀, caeterum ♂; rhachis inter flores ♂ exposita, glabra; bracteae late ovatae, subobtusae, ad 1 mm. longae, sub anthesi olivaceae, albido-marginatae, minute ciliolatae, deinde rubescentes; *Flores* ♂: pedicelli bractea breviores; bracteolae 2, bracteis simillimae, nisi paulo majores, perianthio approximatae. *Perianthium* 4-phyllum; segmenta late oblonga, obtusa, 2 mm. longa, structura coloreque bracteis bracteisque similia. *Filamenta* gracilia, e perianthio breviter exserta; antherae maturae haud visae. *Flores* ♀ plerumque 2 (vel 1 vel 3) ad basin racemorum mixtorum vel rarius in inflorescentiis valde reductis unisexualibus; pedicelli in fructu graciles, ad 4 mm. longi; bracteolae 3-4-pares, ovatae, acutae vel subacutae, vix 1 mm. longae, in pedicello maturo oblique patentes. *Perianthium* 4-phyllum; segmenta late ovata, minute ciliolata, acuta, matura 2-3 mm. longa, haud rubescentia. *Fructus globosus*, 8 mm. diametro, ut videtur atro-caeruleus.

Burma. Maymyo Plateau, 1000 m., flor. 24. x. 1908, *Lace*, 4357; by streams, fruct. 1. iii. 1914, *English*. Upper Burma, without precise locality, fruct. immat., Dec. 1901, *Smiles*.

930. Chrysopogon setifolius, *Stapf* [Gramineae-Andropogoneae]; affinis *C. pallido*, Stapf (Andropogoni pallido, *Kunth*), sed laminis subsetaceis canaliculatis panicula contracta angustissima, spiculis muticis, callo brevi breviter barbato distinctus.

Gramen sine dubio perenne, circiter 4 dm. altum. *Culmi* pergraciles, erecti, simplices, 3-nodi, internodio summo solo exserto. *Foliorum* vaginae basales exteriores haud visae, caeterae teretes, nervoso-striatae, infima dorso, imprimis versus margines, et ad os pilosa, superiores glabrae, laeves, summa lamina destituta; ligulae ad marginem ciliolatum reductae; laminae subsetaceae, lateraliter leviter compressae, ad 20 cm. longae, ad 0·75 mm.

latae, canaliculatae, versus ligulam pilosae, praeter apicem scaberulum laeves, nervoso-striatae. *Panicula* angustissima contracta, ad 9 cm. longa, rhachi gracili apice paulo incrassata albo-ciliolata, ramis glabris laevibusque ad nodos solitariis vel interdum 3-4-tim verticillatis tenuiter filiformibus 5-20 mm. longis erectis; pedicelli filiformes, glaberrimi, ad 4·5 mm. longi. *Spicula* sessilis, lineari-lanceolata, acuminata, pallida, glabra, 8 mm. longa; callus perbrevis, obtusus, barbatus, pilis antice ad 2 mm. longis. *Glumae* aequales, inferior versus margines a medio sursum aculeolata, dorso praeter apicem scabrum laevissima, nervis intracarinalibus circiter 5 tenuissimis, extracarinalibus 2; superior in carina superne aspera, nervis 6-7, margine ciliata. *Valva* anthoecii inferioris 6-7 mm. longa, 2-nervis, reverse ciliata, superioris explanata elliptico- lanceolata, acuta, 4-5 mm. longa, mutica, ultra medium tenuissime 3-nervis, abhinc nervo unico incrassato purcursa; valvula phyllis 2 ad basin lineari-oblongis ciliatis 2-5 mm. longis, 1-nervibus substituta (an normalis?). *Lodiculae* late cuneatae. *Antherae*? *Spiculae* pedicellatae pallidae, anguste lanceolatae, acutae, 8 mm. longae. *Glumae* aequales, glabrae, inferior circiter 11-, superior 3-nerved. *Valva* inferior 6 mm., superior 5 mm. longa, haece tota hyalina 3-nervis. *Antherae* 2·5 mm. longae.

North Australia. Port Darwin, *Schultz* 661.

The replacement of the valvule by two 1-nerved phylla is very unusual, and suggests some anomaly in the development of the spikelets. These appear, however, perfectly healthy in every respect and are of the usual Chrysopogon type, except for the absence of an awn in the upper floret, whose valve is moreover chartaceous over a narrow portion of the back. Even if these peculiarities of the sessile spikelets should prove to be anomalous, the structure of the leaf-blades alone would be sufficient to distinguish this species from all the other species of the Gryllus type.

XIII.—NOTES ON THE EFFECTS OF SHELL FIRE ON TREES IN WOODS IN FRANCE.

We have received from Lieut. T. H. Parsons, Curator of the Royal Botanic Gardens, Peradeniya, Ceylon, who has been serving with H.M. Forces in France, the following account embodying his observations on the effect of shell fire on trees. Three of the photographs, taken by him, showing the destruction are here reproduced.

The following are a few notes obtained on the devastating effect of shrapnel on tree life, from observations made during a short period spent on forestry operations at Manancourt, north of Peronne, in Vaux, and in the St. Pierre Vaast Woods.

The notes refer chiefly to the former wood.

Owing to the poor soil, none of the trees had attained very large dimensions and they consisted chiefly of Beech, Ash, Poplar, Silver Birch, Oak, Cherry and Hornbeam.

As the whole wood was subjected to a fair amount of overhead shell fire, the different effects on the various types of tree could be observed and compared. The Silver Birch and Poplar showed the most adverse, the Beech the least adverse, effects under similar damage by exploding shells.

The photograph (Plate VI.) obtained of the Beech (*Fagus sylvatica*) indicates to some extent the small amount of damage done to it in spite of the fact that the whole trunk of the tree was most generously peppered with shrapnel fragments.

Most of the injuries appeared to have been inflicted on the tree during 1915-16, and but little effect on its vitality was to be seen.

The bark renewal of the tree was extremely rapid. The base of the trunk of this tree was also badly damaged, due, presumably, to horses having been tethered close by at a recent date.

The whole of the Beeches throughout the wood showed similar powers of recovery after being considerably damaged.

Similar injuries inflicted on the Ash (*Fraxinus excelsior*) invariably resulted in the injured branches dying off, but generally the trees made a good recovery afterwards. In a few instances, however, the more seriously injured trees lost the greater part of the head, but showed signs of growing again below the injured part, as seen in Plate VII., fig 2.

As the injuries in the latter case were sustained during the spring and summer of 1918, it has still to be seen whether the pollard growth will continue in subsequent seasons or whether such growth was due merely to utilisation of the reserve materials in the tree.

The Poplars, white and Lombardy (*Populus alba* and *P. nigra* var. *pyramidalis*), invariably died under the effects of even a moderate amount of overhead shell fire, and this was particularly noticeable among the roadside trees.

The Silver Birch (*Betula alba*) similarly succumbed, and usually during the same season in which the damage was inflicted.

Oak trees throughout withstood the damage very poorly, but survived. Many that were injured in 1915-16 are still alive, but linger on in very poor condition.

The Hornbeam (*Carpinus Betulus*) also withstood shell fire very poorly and showed only faint signs of recovery. The fragments of shrapnel usually penetrated into the trunk of a tree to a depth of about 2 to 3 in., but in some instances they were as deep as 5 in. A good example of healing of a deep shrapnel wound is shown in the photograph (Plate VII., fig. 1) of an Oak tree some 18 to 20 in. in diameter. The shrapnel had here penetrated to a depth of 5 in. and a fine healthy callus had begun to develop round the edge of the injury.

The effect of shell fire on trees, therefore, does not appear to have the same adverse effect on a fairly hard wood of reasonably quick growth, such as the Beech, as it has on the softer-wooded trees of more rapid growth, such as the Poplar, or on the harder wood of slower growth such as that of the Oak.

In addition, it was observed that the trees hit most frequently were not necessarily the most seriously damaged ones, as in many cases it was not always the number of wounds that caused the

VI.

[*To face page* 232.

FIG. 1.

FIG. 2.

VII.

To face page 233.]

seriousness of the injuries, but rather the position of such wounds, the shrapnel fragments invariably causing the greater damage when they struck the tree in a slanting direction, causing a long, ragged wound, thus lacerating much more of the bark and cambium layer than happens when the hit is direct and clean.

Explanation of Plates.

Plate VI. A Beech tree showing the trunk deeply pitted and torn by shrapnel.

Plate VII., Fig. 1. A section of the trunk of an Oak showing a shrapnel wound 5 in. deep, around which a cork callus has begun to develop.

Fig. 2. An Ash tree. The upper part has died as a result of shell fire and pollard-like shoots are springing from the trunk below the dead portion.

XIV.—ABRAHAM'S OAK.

Quercus coccifera var. *palaestina*, Boissier.

(Syns. Q. palaestina, *Kotschy*; Q. pseudo-coccifera, *Desf.*)

W. J. Bean.

In February last, Kew received a small box of acorns from Major M. Portal, D.S.O., who was then stationed at the General Head Quarters of the British Army in Palestine. These acorns proved to be those of the Palestine form of *Quercus coccifera*, the Kermes oak, whose various forms are widely spread over South Europe, from Spain and Portugal eastwards to Asia Minor and Syria, and south of the Mediterranean in Algeria. In an accompanying letter Major Portal says:

"I send you a box full of 'Ilex' acorns from the only large clump of trees I have seen out here. It is near Kebara, about a mile on the Jerusalem side of Enab, and, according to the map, situated at an elevation of 2400 ft. This clump, some 50 yards by 30 yards, grows near the bottom of a valley and close to the ruins of an old castle reputed to date back to Crusader times. In this country it is surprising that the Turk has allowed these trees to grow to their present age and size, but there is a grave in the middle of the clump which probably may account for it. The largest tree in the clump has a trunk 9 ft. 5 in. in circumference at 3 ft. from the ground; another has a girth of 4 ft. 11 in."

It is now generally conceded that this Palestine oak, as well as some half a dozen others to which specific names have been given, are nothing more than local forms of the Kermes oak, *Q. coccifera*, a species which, though never common, has long been cultivated in English gardens. Sir Joseph Hooker pointed this out as long ago as 1861 in a well-known paper contributed to vol. xxiii. of the Transactions of the Linnean Society. He had, in the autumn of the previous year, made a short tour in Syria, in company with Mr. D. Hanbury. Although in this

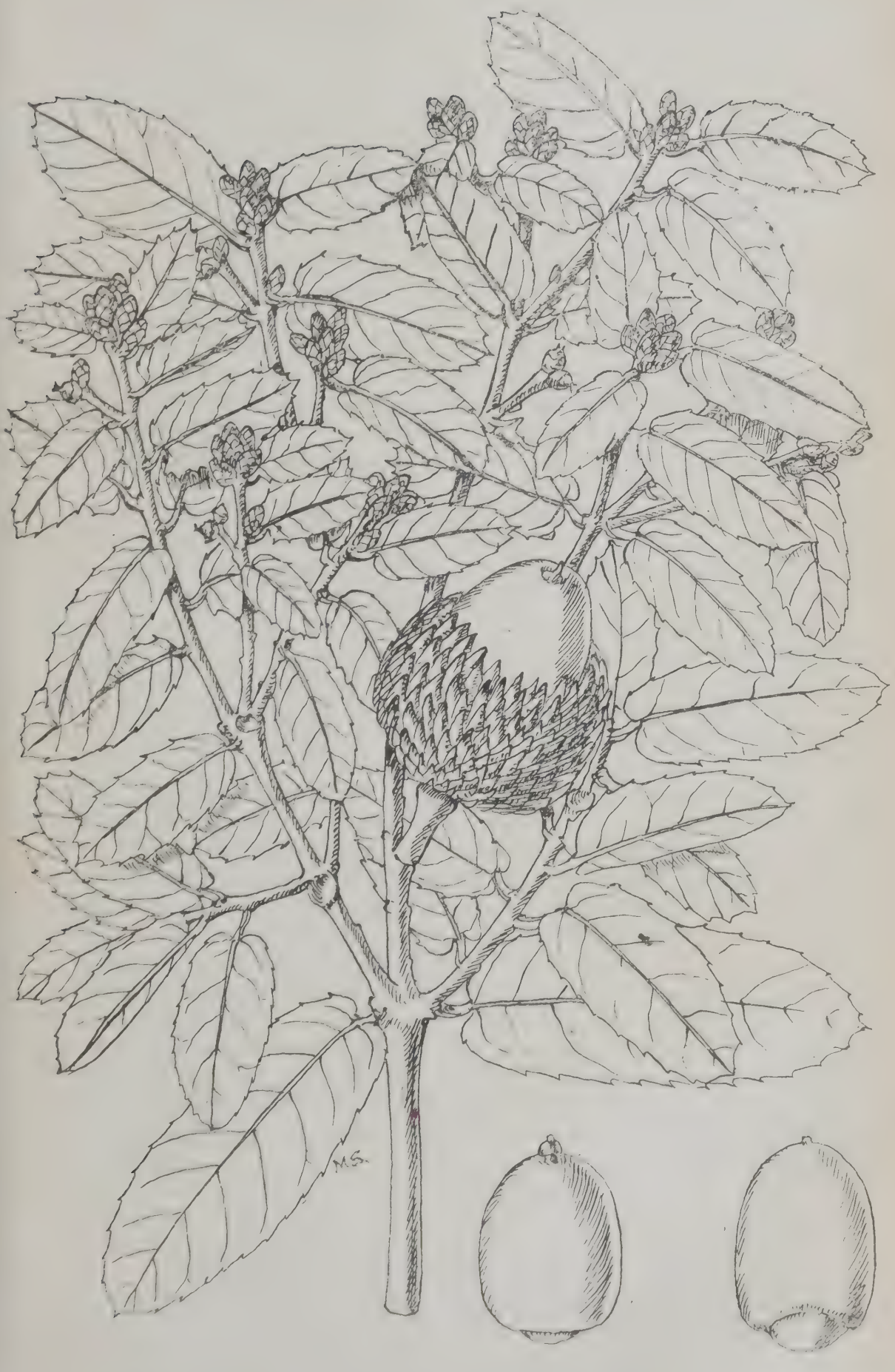
paper he adopts Desfontaines' name *Q. pseudo-coccifera* for the Palestine tree, he says "how far it is permanently distinct from *Q. coccifera* of Spain and Italy may reasonably be questioned; the characters given, even if constant, amount to no more than enough to establish a variety upon."

Writing of this oak as seen by him in Palestine, he says it is "by far the most abundant tree in Syria, covering the rocky hills with a dense brushwood of trees, 8 to 12 ft. high, thickly covered with small, evergreen, rigid leaves, and bearing acorns copiously. On Mount Carmel it forms nine-tenths of the shrubby vegetation, and is almost equally abundant on the west flanks of the Anti-lebanon and many slopes and valleys of Lebanon." The infrequency of trees of large size to which Major Portal refers, was also noted by Hooker, who attributed it to the indiscriminate destruction of the Syrian forests under the Turkish regime. Probably the need for fuel was the prime cause, for even in localities where it was no longer to be seen, as in the valleys south of Bethlehem, he states that its roots were sought for in the soil, and dug up for burning.

In the brighter era which is in prospect for that country now that Turkish control has come to an end, it is to be expected that the rehabilitation of its forests will be one of the first concerns of the new government.

In comparing the forms of *Quercus coccifera* which occur at the extremes of its natural distribution, say in Spain and in Palestine, the chief difference appears to be in stature. At the western limits of its habitat it is usually a bush a few feet high, rarely a small tree, but in the East, as we see from the dimensions given by Major Portal, it is a goodly sized tree, capable of making a trunk one yard or more in diameter. The eastern form too has, in general, larger leaves and acorns. But although there is great variation in the shape and toothing, as well as in the size of the leaves, no attempt to base specific distinctions on these differences has been really successful. Hooker remarks that "not one of these characters holds good with any approach to constancy in Syria, where large and small, more or less membranous, and more or less waved and spiny leaves occur on individual plants and, more conspicuously, on adjacent ones. On Carmel, just below the convent, we gathered two forms, with interlocked branches, with the typical leaves attributed respectively to *pseudo-coccifera* and *coccifera*, but with identical acorns." The acorns, too, show great differences in size and contours. In Hooker's paper, illustrations of about twenty are given to show the range of variation. In our plate the acorns shown are comparatively broad in proportion to their length. Those in the parcel sent by Major Portal varied in length from $\frac{1}{2}$ in. to $1\frac{1}{2}$ in., but smallness does not appear to indicate any arrested development, for large and small have germinated equally well in the Arboretum nursery at Kew.

The most famous of all oaks in Palestine is the venerable tree known as "Abraham's oak," or the "Oak of Mamre." It grows at Hebron, just below the Russian Convent, which overlooks the Plain of Mamre, and is the largest known example of this


M.S.

Palestine form of *Quercus coccifera*. This tree is popularly supposed to mark the spot where grew the oak, or lentisk, under which Abraham pitched his tent, and it is on this account held sacred by Christian, Jew and Mahommedan alike. In its prime the trunk of this tree was 23 ft. in girth and the spread of its branches 90 ft. Accompanying Hooker's paper, alluded to above, is a reproduction of a drawing made by himself of this oak. He notes a curious difference in the contours of the branches on its opposite sides; on the western or Mediterranean side they are much stunted, denser and more rigid than on the eastern or inland side, where they are distinctly pendulous. Nearly thirty years after Hooker's visit to this tree, a reproduction of a photograph of it, taken by Mr. F. Skinner, of Boston, Mass., appeared in "Garden and Forest," 1889, p. 607. Some attempt at its preservation had evidently been made in the meantime, as the trunk is seen to be enclosed by a low wall, and some of its branches are propped up. But although the main outlines of the tree are very much the same as indicated in Hooker's drawing, it appears to have become much scantier of foliage and less vigorous, with the marks of age more pronounced.

In the Herbarium at Kew, there is a leafy specimen collected from Abraham's oak by Hooker and Hanbury in October, 1860, and in 1893, a block of wood from it was presented to Kew by Mrs. E. A. Finn. Mr. Finn, the husband of this lady, was British Consul at Jerusalem from 1845 to 1863. During the winter of 1856-57 there was a great snowstorm in Jerusalem, in the streets of which the snow lay deep for many days. The accumulation on Abraham's oak was so great that it broke off one of its finest branches, and it was from this branch that the block now preserved in Museum III. at Kew was cut. It is 2 ft. 10 in. long, and 1 ft. 7 in. wide. Hooker tells us that, owing to a supersition that any person who should cut or maim this oak would lose his first-born son, considerable difficulty was experienced in procuring hands to saw up the timber for transportation. When this was done it was found that the wood from this one limb was sufficient to load up seven camels.

The largest tree of which we know in the British Isles is growing in the Vicarage garden at Bitton; it is about 20 ft. high.

In the *Kew Bulletin* for 1910, p. 167, an account of *Quercus coccifera* is given, chiefly in relationship to its connection with the dye known as scarlet grain. This dye is obtained from an insect, *Coccus Ilicis*, commonly known as "Kermes," which breeds on this oak. Hooker observes, however, that he saw no Kermes in Palestine.

XV.—MISCELLANEOUS NOTES.

Mr. J. Hutchinson, Assistant for India in the Herbarium of the Royal Botanic Gardens, Kew (*K.B.*, 1915, 356), has been appointed by the President of the Board of Agriculture and Fisheries, an Assistant, Second Class, in the Royal Botanic Gardens.

Mr. Alfred Keys, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Assistant Curator of the Botanic Station, Dominica.

Mr. H. L. R. Chapman, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Egyptian Ministry of Agriculture, on the recommendation of Kew, a Superintendent in the Horticultural Section of the Ministry.

Dr. I. B. Pole-Evans.—We learn with interest from the "Pretoria News," of May 16, that the Captain Scott Memorial Medal for Research has been awarded to Dr. I. B. Pole-Evans, Chief of the Division of Botany, Department of Agriculture, South Africa, by the South African Biological Society. This is the second award of the medal, the first award, made last year, having been to Sir Arnold Theiler, in recognition of his veterinary research.

Casimir de Candolle.*—The third generation of the celebrated de Candolle family has passed away in the person of Anne-Casimir-Pyramus de Candolle. Born at Geneva on the 20th February, 1836, Casimir de Candolle commenced his scientific studies in 1853 in the Faculty of Sciences, Paris, where he devoted himself principally to chemistry, physics and mathematics, and obtained in due course the degrees of B.èsSc. and L.èsSc.

He assisted his father, Alphonse, in editing the last two volumes of the *Prodromus*, and was joint-editor with him of the *Monographiae Phanerogamarum* which succeeded it. His first taxonomic work was a revision of the *Juglandaceae*, which appeared in the *Prodromus*, followed in 1869 by a revision of the *Piperaceae* in the same work; his interest in the latter group continued to the end of his life, and specimens of *Piperaceae* were sent to him from all parts of the world for determination. A monograph of the *Meliaceae* from his pen appeared in the *Monographiae Phanerogamarum*.

Casimir de Candolle was interested in many other departments of botany, as is shown by the wide range of his published works. His mathematical bent found expression in a series of papers on phyllotaxy. Amongst his anatomical contributions may be mentioned a memoir on the comparative anatomy of the leaf in some families of Dicotyledons, and his interest in systematic anatomy no doubt led to the inclusion in the *Monographiae Phanerogamarum* of Vesque's revision of the *Guttiferae*, in which extensive use is made of anatomical characters. His physiological work included memoirs on the effect of low temperatures on the

* Dr. J. Briquet has given a very interesting account of M. de Candolle's work in Mém. Soc. Phys. Hist. Nat. Genève, vol. xxxix. fasc. 2, pp. 89–98 (1919).

germinating power of seeds, and on the action of the ultra-violet rays in the production of flowers; and his keen interest in morphology was shown in papers on epiphyllous inflorescences and on peltate and pitcher-shaped leaves.

He upheld the family traditions in affording botanists free access to the classic Candollean herbarium and library, and the extension of the latter was the subject of his special care.

After a long and painful illness he died at Vallon, near Geneva, on the 3rd October, 1918. One of his sons, Augustin de Candolle, carries on the botanical tradition of the family in the fourth generation.

The Oil Palm.—In the Bulletin Agricole de l'Institut Scientifique de Saigon, vol. i., pp. 154–5 (May, 1919), Dr. Aug. Chevalier describes a variety of the oil palm under the name of *Elaeis guineensis*, sub-sp. *nigrescens*, var. *Poissoni*, A. Chev., about which a note (based on a specimen sent from near Calabar by Mr. W. H. Johnson) was published in the *Kew Bulletin*, 1913, pp. 92-93. It has also been named *Elaeis Poissoni* by Lieut. Annet in the Congrès d'Agriculture Coloniale de Paris, 24th May, 1918. The leading feature of this variety is the persistent fleshy perianth, which, like the seed, is rich in oil, and surrounds the fruit like a cupule. In Nigeria this variety is know as "Ayara Buvana," or "Ayara Mbana," and in French West Africa "Agode." P. Janssens in Bull. Agric. Congo Belge, ix. p. 225 (1918), states that at Mayumbe, on the lower Congo, it is called "Vuakania" and "Nagazi ya mabele," and at Ponthierville, also on the Congo, "Basatum." In Togoland and at Dahomey it bears the name "Klude" or "Klode." According to Dr. Gruner, 61 seeds of "Klude," planted in 1905, produced 51 palms, which bore "Klude" fruits, and 10 palms which bore fruits of "Dento," or the ordinary variety. C. H. W.

Strychnos Nux-vomica in Cochin China.—In *K.B.*, 1917, p. 121, a general revision of the genus *Strychnos* in India and the East was published, and on pp. 184-185, reference was made to *S. Nux-vomica* in Indo-China, and some doubt was expressed as to its occurence there in a wild state. Later on some evidence bearing upon this point was received, together with some seeds collected from wild trees in Cochin China, which conclusively proved that the species was indigenous [see *K.B.*, 1917, p. 341]. Quite recently Dr. Auguste Chevalier kindly forwarded to Kew samples of Nux-vomica seeds collected in Benhoa and Barea, Cochin China, and from Bangoi, Annam. In Bulletin Agricole de l'Institut Scientifique de Saigon, May, 1919, p. 160, Dr. Chevalier notices the earlier paper in the *K.B.*, but apparently not having seen the subsequent note [1917, p. 341], gives the following particulars of interest. *Strychnos Nux-vomica*, is one of the most characteristic trees of certain forests of Cambogia, of Cochin China (Baria, Benhoa, Thudaumot, Chaudoc, Tayninh), and of the South of Annam. In the last

country it is particularly abundant in the province of Phanthiet (Binh-tang), where Loureiro had already noted it in 1790, under the name of "Cây Cu-chi," which is still actually the Annamite name of this species in all Indo-China. The port of Bangoi exported before the war about 15 tons collected in this region, and bought by Chinese and German merchants. The Scientific Institute is taking means at the present time to recover the trade, and will make known the result later. J. M. H.

Viburnum Carlesii, var. **syringiflora.***—From about the beginning of May of this year, one of the most charming beds of flowering shrubs at Kew has been that of *Viburnum Carlesii*, by the side of a path leading from greenhouse No. 4 to the old rock garden. This beautiful Corean shrub combines with its delightful clusters of pink-white flowers a most agreeable scent, and as an indication of the "hit" this species has made on the horticultural mind, one need only turn to the pages of the gardening periodicals, where it has been frequently described and figured during the month of May for the last few years. Mr. Beckett, in the "Gardeners' Chronicle" for May 6th, 1916, p. 242, writing in praise of *V. Carlesii*, says: "Unfortunately there are two varieties in existence, one of which is much inferior to the other." This inferior variety, together with the true form, has recently been forwarded to Kew by Messrs. Robert Veitch & Son, of Exeter, with the request that the poorer form should be given a distinctive name, in order that it may be distinguished in trade. It differs from true *V. Carlesii* in its less hairy leaves, which are also probably more fully developed at the time of flowering than are those of the type, its laxes and smaller flowers with much smaller spread of corolla limb, and according to Messrs. Veitch, there is also some difference in habit. As pointed out, it is desirable that this plant should be named, and I therefore describe it here as *V. Carlesii*, var. *syringiflora*, from the general resemblance of the flowers to those of a lilac. That this plant deserves only varietal rather than specific rank seems probable, because it does not appear to have been gathered yet in a wild state. Probably Mr. E. H. Wilson, who has lately been travelling in Corea, may have met with it. J. H.

Botanical Magazine.—The following plants are figured in the number for January, February and March:—*Rhododendron auriculatum*, Hemsl. (t. 8786), from Central China; *Isabelia virginalis*, Rodr. (t. 8787), a native of Brazil; *Ipomoea dasysperma*, Jacq. (t. 8788), from Tropical Asia and Africa; *Rhododendron callimorphum*, Balf. f. & W. W. Sm. (t. 8789), from Yunnan; *Aloe concinna*, Baker (t. 8790), from Zanzibar; *Primula chasmophila*, Balf. f. (t. 8791), a native of Bhutan; *Bulbophyllum robustum*, Rolfe (t. 8792), a native of Madagascar;

* *Viburnum Carlesii*, var. *syringiflora*, Hutchinson, var. nov.; a typo foliis sub anthesin bene evolutis parce stellato-puberulis, inflorescentiis laxis, corollae limbo multo minore et habitu differt.

Protea longifolia, Andr. (t. 8792), from South Africa; *Govenia lagenophora*, Lindl. (t. 8794), a native of Mexico; *Deutzia compacta*, Craib (t. 8795), from China, and *Primula tibetica*, Watt (t. 8796), a native of the Eastern Himalaya and Tibet.

A Garden Flora: Nymans*.—The collection of trees and shrubs, formed by the late Mr. L. Messel at Nymans, has for many years been well known as one of the richest in rare species existing in the south of England. Mr. Messel, who died in 1915, was an ardent experimenter and made a speciality of introducing to his garden and acclimatising there reputedly tender and difficult things. Recognising the fact that many species are more particularly liable to succumb to the adversities of our climate whilst they are young and small, he built glasshouses where tender and doubtful species could be grown on with some protection until they were of a size and strength to fit them for planting in the open ground. He thereby gave them a much better chance of surviving than if they had been put out as quite small plants. Mr. Messel's successes were quite remarkable, for Nymans is situated on the Forest Ridge of Sussex and part of the garden is 500 ft. above sea-level. He was, for instance, the first to flower *Embothrium coccineum* out of doors in a garden so near to London. The present volume, a copy of which has been presented to the Kew Library, is a list of the plants grown at Nymans. Of this list the trees and shrubs constitute the most important section. It was compiled by the owner's daughter, Miss Muriel Messel, who also contributed very interesting short notes on the more remarkable species, more especially in regard to their history and behaviour at Nymans. Her work forms a valuable record and will be extremely useful as a guide to planters generally, but especially to people whose gardens are situated in localities where the climatic conditions approximate those of Nymans. It is illustrated with ten drawings of rare trees and shrubs by Mr. Alfred Parsons, R.A., and is most admirably printed on beautiful paper. Had Miss Messel lived to see the publication of her work, she could have been congratulated on producing a very pleasant and attractive, as well as useful, volume; unhappily she succumbed to an attack of influenza last December. The book is inscribed to her father's memory, but it is pleasant to feel also that it will keep in long remembrance a young and charming personality cut off in the flower of her age. W. J. B.

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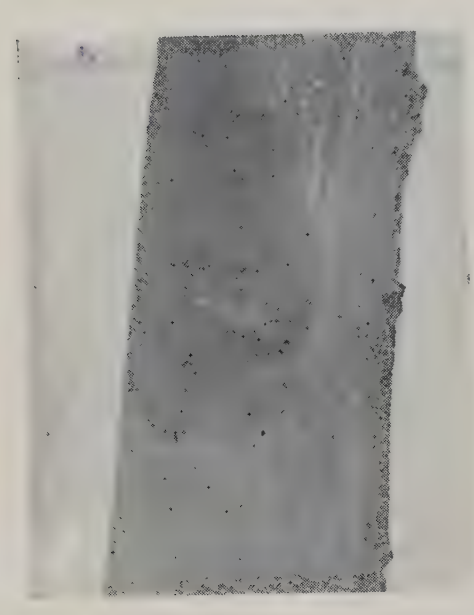
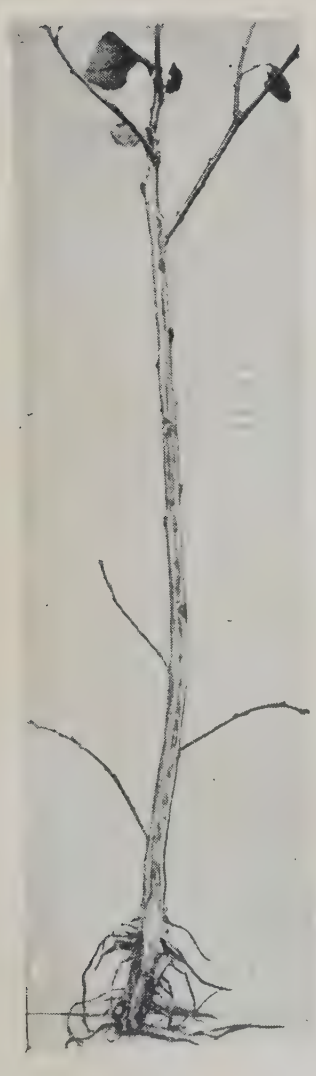
* A Garden Flora. Trees and Flowers grown in the gardens at Nymans by L. Messel, 1890-1915. With illustrations by Alfred Parsons. Foreword by W. Robinson. Notes by Muriel Messel. Published at the offices of "Country Life."





VIII.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 6 & 7] [1919

XVI.—SILVER LEAF DISEASE.*

Stereum purpureum.

J. BINTNER.

(With Plate.)

I.—INTRODUCTION.

"Silver leaf" is notorious not only for the serious damage which it causes to fruit trees but also for the controversies concerning the nature of the disease.

The first observations were made by Prillieux (1) 1885 in France, and published under the title of "Le Plomb des arbres fruitiers." He considered the leaden colour of the leaves to be the result of the presence of large air spaces between the epidermal and palisade cells; he also noticed larger epidermal cells in the infected leaves than in the normal leaves. In 1886 Sorauer (2) referred to the "Milchglanz" of fruit trees, and again Aderhold (3) in 1894, mentioned it as occurring in Germany. Both these authors considered "Silver leaf" of fruit trees as of non-parasitic character. This theory however became very improbable on the discovery, made in England by Percival (4), who in 1901 applied the name "Silver leaf" to the disease, that fungal hyphae existed in the wood of silvered plum-trees. Successful inoculation experiments by Percival, who proved that silvering could be caused by the fungus *Stereum purpureum*, did not however convince all his contemporaries. Massee (5), for instance, still attributed the disease to some physiological disturbance. Delacroix (6) erroneously states that Percival had described *Stereum hirsutum* as the cause of silvering, and even adds: "Malgré l'affirmation de cet auteur (Percival), nous ne pouvons, jusqu'à plus ample informé, admettre de telles conclusions." Blackmore (7) in commenting on this disease in his report on New Zealand diseases, states that "Silverblight certainly is becoming very prevalent in a number of orchards in North Otago and elsewhere. Often where fruit trees are making succulent growth it spreads rapidly, killing trees within

* This research was carried out in the Laboratories of the Department of Plant Physiology and Pathology, Imperial College of Science and Technology, South Kensington. Mr. Bintner was formerly a Sub-Foreman in the Royal Botanic Gardens.—ED.

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two years. For a long time I have noticed that with fruit trees which have been killed by Silverblight, there occasionally appears on the stem or branches some time after the death of the tree the fructification of a fungus: but so much has been said in reference to Silverblight being due to bacteria that I do not think the roundish disc-like fungus growths are connected with Silver leaf disease." Later he adds: "I however forwarded specimens to England to a friend, who identifies them as the same fungus which is considered by Professor Percival and others to be the cause of Silver leaf disease of fruit trees in the United Kingdom." The above quotations clearly indicate the scepticism of a number of workers with regard to Percival's discovery. The latter's views were, however, confirmed by Pickering (8) at Woburn during 1906-1909, as the result of a large number of successful inoculations of various fruit trees and a few other trees and shrubs with *Stereum purpureum*. Similar results, with equal success, were obtained in the detailed work at Cambridge and Merton of Brooks (9). Güssow (10) observed Silver leaf in Canada and repeated with success similar inoculation experiments. The latest contributions on Silver leaf by Smolak (11) leave that author still doubtful as to *S. purpureum* being the sole cause of Silver leaf. He discovered bacteria in silvered leaves, but he considered them of secondary nature.

In view of the wide distribution of this insidious disease, throughout the continent of Europe, from England to the Balkans, and in America, where, according to Güssow (12) it is prevalent in Canada, from St. John's, Newfoundland to Vancouver Island, and also in Australia and New Zealand, it is plain that Silver leaf is very likely to hamper considerably the fruit growing industry throughout the world unless prompt action is taken to cope with the disease. Unfortunately in England the best varieties of cultivated plums are most susceptible to Silver leaf, as can be judged from the plum orchards in Surrey, Middlesex, Kent, and Worcestershire, where in certain plantations 60-95 per cent. of the plum trees of "Victoria" and "Czar" varieties have been so severely attacked that wholesale grubbing out of these trees has had to be resorted to.

The following gives a list of plants known to be affected by Silver leaf:—

Those marked with * have been observed by the author, those marked *† are new records.

Rosaceae.

*†1. *Neviusia alabamensis*, A. Gray.

*2. *Spiraea japonica* var. *glabrata*, Lange.

3. *Philadelphus* sp.

4. *Exochorda* sp.

5. *Pyrus Malus*—cultivated varieties of Apples.

*Lord Grosvenor.	Newton Wonder.
*Bramley's Seedling.	Lord Suffield.

P. prunifolia.

**P. triloba*, Lindley. var. *flore pleno.*

*6. *Prunus Amygdalus*, Stokes, and cultivated varieties of Almonds.
P. Armeniaca, Linn. and cultivated varieties of Apricots.
**P. Avium*, Linn., Gean.
**P. Cerasus*, Linn. and cultivated varieties of cherries.
**P. communis*, Hudson. Wild Plum.
†*P. japonica*, Thunberg.
**P. lusitanica*, Linn. Portugal Laurel.
**P. spinosa*, Linn. Sloe.
*†*P. acida*, Ehrhart. var. *flore pleno*.

7. Cultivated varieties of Plums:—

Pond's Seedling.	*Victoria.
Monarch.	*Czar.
Gisborn.	*Belgian Purple.
Several gages.	*Damsons.

8. Stocks used for grafting:—
*†The Brompton.
*†Myrobella (*Prunus myrobolanus*).
*†Common Plum stock var.

Saxifragaceae.
*†*Ribes cereum*, Douglas, and cultivated varieties of Gooseberries and Currants.

Leguminoseae.
**Laburnum vulgare*, Presl.
*†*L. alpinum*, Presl.

Oleaceae.
Syringa sp.

Sapindaceae.
Aesculus Hippocastanum, Linn.
*†*A. carnea*, Hayne. var. Briotii.

Ericaceae.
*†*Pernettya mucronata*, Gaudich.

†Noted by Mr. F. J. Chittenden at the R.H.S. Gardens, Wisley.

All material used for examination, as described in this paper, was secured from naturally infected "silvered" plants growing in the open, not from artificially inoculated plants, nor from branches which had been killed by the fungus. The plants were marked in the field during the summer of 1918, and from October onwards, and material was taken, as required, to the laboratory. Unfortunately the leaves could not in all cases be examined, as the majority of plants were of a deciduous character, so that the leaves had dropped before the microscopic details could be studied.

The tracing of the fungus in diseased tissues is by no means an easy task, owing to the fact that the hyphae are extremely fine. The following method was adopted:—The material was cut into cubes of about 1 cm. and steeped for 6-8 days, or even a fortnight according to the nature of the material, in a saturated solution of picric acid in 50 per cent. alcohol. For sections,

soaking for 4-6 hours is sufficient. The excess of picric acid is washed off and the section stained with concentrated Delafield haematoxylin (ripe solution) for at least 4-6 hours, or preferably overnight, according to the nature of the material. Picric acid stains lignified tissues a yellow-citron, and haematoxylin imparts a blue colour to the hyphae.

In the following account a description is given of the diseased condition as found in the following plants, in which the hyphae of *Stereum purpureum* have been observed.

II.—Specific Cases.

(1) **Victoria Plum.**—The Plum orchards in the Brentford and Heston district of Middlesex suffered severely from Silver leaf during 1918; eighty to ninety per cent. of the plum trees (of ages from 5-30 years), chiefly the varieties "Victoria" and "Czar," were so severely affected that they had to be cut down during late summer and early autumn. Owing to a scarcity of labour the sawn-off branches and tree-stumps were not removed from the plantations. The first fructifications of *S. purpureum* developed during the last week of September on this dead wood and also on silvered trees still standing. Undoubtedly diseased wood in the plantations will endanger plum and other trees in the neighbourhood. The plum trees met with in the orchards of this locality were mainly grafted on the "Brompton" and "common plum" stocks. Generally where suckers grew up from the stocks of silvered plants, they showed silvering relatively to the same extent as the scion, and this irrespective of the age of the plum tree. In a few cases, however, I noticed normal suckers of "Brompton" and "common plum" stock coming up from silvered trees. Healthy suckers were most common on partially silvered plants, that is, where only *localised* branches of a tree were attacked, mainly where only the upper set of branches was affected by the disease. I also noticed on a few completely silvered trees healthy suckers of the above varieties arising from the stocks. Silvered suckers, one year old, to the number of 150, were dug up and their roots examined; 10 of these were taken to the laboratory, and 140* were examined in the field. Of the latter 26 appeared normal to the naked eye in roots and stem, whereas the remaining 116 revealed discoloration of the tissues in cross section of roots and at the base of the stem. A few two-year-old suckers were also examined and the discoloration was still more obvious. The discoloration in the 10 suckers mentioned above could easily be traced up the suckers for two-thirds to three-quarters of their length. The discoloration usually consisted of 2-4 reddish brown streaks which sometimes ran parallel, but frequently followed a winding or twisting path in the stem. The streaks were confined to the outermost xylem.

The following table indicates the height reached by the discoloration and by the hyphae in five one-year-old suckers.

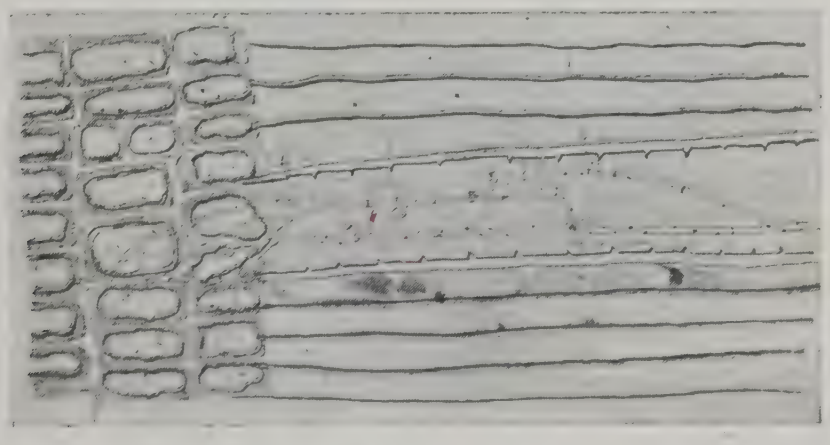
* These 140 suckers have been planted in the experimental plot of the Royal Horticultural Society Gardens, Wisley.

Number of Sucker.	1.	2.	3.	4.	5.
	cm.	cm.	cm.	cm.	cm.
Total length of sucker from its point of origin	110	140	102	80	95
Height reached by the discoloration visible to the naked eye	65	83	52	51	60
Height reached by the hyphae	62	79	51	47	58

For some little distance above the point where the brown streaks cease to be visible to the naked eye the microscope shows scattered patches of brownish material in the vessels.

In completely silvered trees and in those where the lowest set of branches (the first branches developed on the stem) were infected the discoloration was continuous from the twigs into the branches, down the main stem, through the point of union between scion and stock, into the superficial roots of the latter, and from these roots it could be traced again upwards into the stem of the sucker.

In agreement with previous workers, I found that no trace of hyphae could be observed in the leaves or petioles of silvered plum trees and suckers. Hand-sections made from the discolored zone of the root stock, branches and twigs, and of the roots and stems of suckers, disclosed the exceedingly minute hyphae which, when stained, could be seen invading the wood vessels in all directions. In suckers the fine hyphae extend from the cambial region inwards into the wood parenchyma; they sometimes keep a straight course in the discoloured vessels, but occasionally branch when a few filaments may trespass upon the yellowish-brown deposit of the cell-cavity. The hyphae do not seem to enter a vessel at any particular spot, since they can be seen passing across the lignified walls in their thickest parts, and they develop luxuriantly in the lumen of the vessels. They can also be traced in the intercellular spaces, as in Text fig. 1,



Text fig. 1.—Longitudinal section through the wood of a silvered plum sucker, Brompton stock.

in fact, wherever there is room for development. In the living tissue no hyphae were found outside the cambial region: but in

branches or superficial roots which have been killed by the fungus, and where there is an indication of the fructifications beginning to pierce the bark, the hyphae are naturally present in practically all the tissues. The hyphae are septate, and clamp connections frequently occur (see Fig. 1). The brown material on which the discoloration depends is found mainly in the xylem vessels, but some cavities and the walls of the medullary ray cells are also stained, as well as certain cambium cells.

(2) **Prunus lusitanica.**—Among the evergreen members of the Pruneae, this is the only species which up to the present has been found to suffer from Silver leaf disease. The material selected for the present investigations was secured from the Prunus collection in the Royal Botanic Gardens, Kew. On individual plants several branches showed silvering, the youngest leaves of the current year's growth seeming to be most severely attacked. The curling over of these leaves rendered them very noticeable at a distance. The upper and lower epidermis were found in many instances to be loosened and even hanging in shreds as a result of contact with other branches and leaves (see Plate). The previous year's leaves and also those of early spring growth, though severely affected, did not display any curling or blistering. The upper and lower epidermis of such diseased leaves could be peeled off with a penknife with comparative ease. On cutting off branches from one to five years old a conspicuous discoloration was to be observed in the region of the outer xylem; only in branches five to ten years old, however, did the discoloration extend into the older xylem. A branch which had its origin below ground was cut off immediately above the soil level; three weeks later, towards the end of September, fructifications of *S. purpureum* developed on the cut surface of the part of the branch still attached to the plant, the fructifications taking their origin from the region of the young wood. Another 8 in. was then cut off and in turn fructifications were produced 23 days later on the surface so exposed.

Satisfactory hand sections of the curled leaves were clearly unobtainable; and even from less infected leaves no suitable sections could be cut, without the cells of the tissue falling apart. In order to avoid the separation of the cells, the material, after fixing in strong Flemming's fluid, was imbedded in paraffin. When staining with E. F. Smith's method, I perceived bacteria-like structures in a few of the lower epidermal cells of the curled leaves. As the epidermis of these leaves was detached from the other tissue, these bacteria are most likely saprophytic and to be considered secondary in nature; they were absent in those epidermal cells where no dissolution of the middle lamella had taken place. No hyphae could be seen in any part of the leaves or petioles either in cross or longitudinal sections. In one-year-old twigs a few threads occasionally passed from the cambial layer into the bast parenchyma, causing discoloration of the latter, but the hyphae were most prevalent in the primary wood vessels, which in turn showed distinct discoloration.

(3) **Prunus triloba** var. **flore pleno.**—In 1916 localised silvering appeared on a few individual plants of this variety which were growing in a bed at Kew; but in the late season of 1918 the disease had spread to many other plants in the same bed, a few of which were completely silvered. In December several silvered branches were cut off and examined. When removing the bark with a pocket-knife the peculiar discoloured streaks were noticeable again, similar to those mentioned under "Victoria Plum." In the case of one three-year-old branch these discoloured streaks were followed upwards into the terminal bud of the current year's growth. A very characteristic feature in the silvered branches of *Prunus triloba* is that the bark can be stripped off with comparative ease. On two shrubs *Stereum purpureum* fructifications were developing.

Owing to the season being so far advanced, no leaves could be examined. When cutting hand sections of the diseased stem, the same difficulty in obtaining intact slices was experienced as with silvered leaves of "Victoria Plum." Abnormal air spaces occurred in the bast of affected twigs. The cambial cells and the cells of the adhering tissues fell apart from the xylem. Isolated, single phloem-parenchyma cells were found floating free on the slide; thus the separation of these cells resembles the separation of the mesophyll cells of the leaves, resulting apparently from the same cause, namely, the dissolution of the middle lamella. In the three-year-old branch mentioned above, the hyphae were traced to within a centimetre of the terminal bud. Text Fig 2 indicates hyphae in the xylem vessel.

Text fig. 2.—Longitudinal section of *Prunus triloba* var. *flore pleno*, showing hyphae in the xylem vessels bordering the cambium.

The severe pruning to which this variety of *Prunus* is annually subjected immediately after flowering undoubtedly increases the opportunities for the entrance of the fungus.

(4) **Apple Trees.**—In October, 1918, Messrs. White & Sons, Paddock Wood, Kent, forwarded to me twigs and leaves of "Grenadier" and "Lord Grosvenor" apple trees which were attacked with Silver leaf. It was practically impossible to cut entire hand sections of the leaves of "Lord Grosvenor" without the tissue falling apart, owing to the fact that they exhibited a phenomenon similar to that of the leaves of plums. The

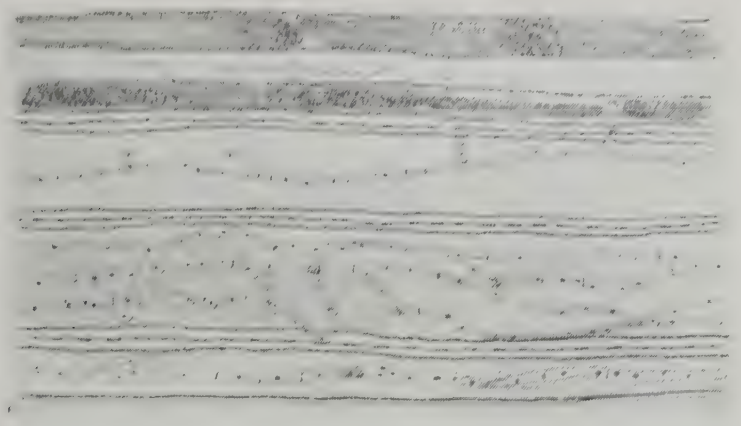
upper epidermal cells separated as a layer from the palisade cells; the palisade cells fell apart and were found to be filled with a brownish coloured material which gave a silver-brown appearence to the leaves. No hyphae were to be obtained in the leaves or petiole, nor could they be traced in any of the twigs which measured less than 8 in. in length, although these twigs showed on cutting conspicuous discoloration from the basal end upwards.

The variety "Grenadier" was only slightly attacked, and instead of a shiny grey brownish tint on the upper surface, as in "Lord Grosvenor," the leaves were a dark leaden colour. There was no separation or falling apart of the epidermal or palisade cells. In hand sections, the leaves seemed almost normal, with the exception of a reduction in chloroplasts, and there was no sign of discoloration in the twigs. Although I was unable to examine the trees in the field, it is presumable from the information received, together with the above observations, that the apparent silvering in the variety "Grenadier" cannot be attributed to the action of a foreign organism; the lead colour is probably due to some physiological weakness of the tree.

Early in January, 1919, I observed a tree, stated to be "Bramley's Seedling," growing in a cottage garden at New Cross, London, which produced numerous confluent masses of fructifications of *Stereum purpureum* on a side-branch towards the base of the stem; the branches developing immediately above this on the same side of the tree produced also tiny scattered tufts of the fungus. On cutting off the lowest branch near the stem, the characteristic browning could be seen at the amputated ends, and on removal of the bark the discoloration was found to extend down to the roots. The discoloration extended from the superficial roots upwards into the main stem, whence it passed into the main branches and twigs, affecting about half of the crown of the tree, the other half being apparently normal. In the main stem a segment of the wood, occupying about one quarter of the whole area in transverse section, showed marked discoloration which extended from the cambium to the pith. Owing to the very advanced state of the disease it was difficult to draw definite conclusions as to whether infection took place below soil level or from injured branches. Curiously enough, the diseased part of the tree had suffered severely during the last few years from "American Blight" (*Eriosoma lanigera*): the damage caused by these insects was very marked on the branches and the twigs, as shown by the presence of intumescences and abnormal growth. It is highly probable that the punctures and the subsequent wounds produced by this insect facilitated the penetration of *S. purpureum*.

Well-developed mycelium in the twigs, branches and main stem was to be observed in longitudinal sections of the discoloured wood. The fine threads could be easily traced from the branches into the fruiting spurs, but with greater difficulty in the one-year-old twigs; the hyphae branched frequently and were of irregular thickness (see Text Fig. 3). They were found more abundantly in the external layers of xylem than in the inner;

and they were particularly abundant in the scattered vessels or tracheids which contained no brown material. In the medullary rays the "browning" of the cells was very irregular, some of



Text fig. 3.—Hyphae of *Stereum* in the wood vessels of apple, "Bramley's Seedling."

the cells containing hyphae having brown walls and contents, while others, which contained hyphae, were otherwise unaltered.

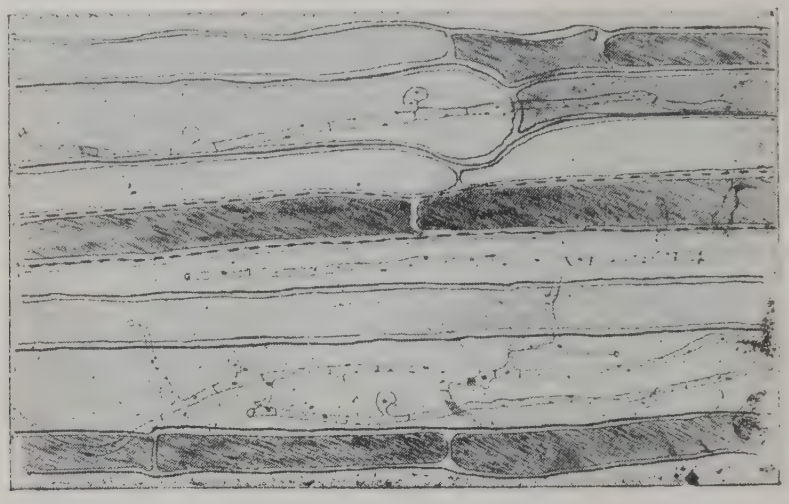
(5) **Spiraea japonica** var. **glabrata** (**sp. glabrata**).—In October, 1918, I observed one silvered shoot of the current year's growth in one plant amongst 33 others growing at the Royal Botanic Gardens, Kew. This Spiraea belongs to the section which is pruned to about 4 to 6 inches above the ground. The first two buds lying below the point of pruning were dead, and the silvered shoot had developed from the next bud at a point about 5 cm. below the cut surface. On splitting the branch which bore the silvered shoot, slight discoloration of the wood could be traced from a point about 3 cm. below the silvered shoot to its point of origin, and then up that shoot to a height of 4 cm.

The leaves could not be examined microscopically. In the roots and in other parts of the shoot no trace of hyphae was to be seen except in the discoloured tissues. The hyphae were followed downwards for 5 cm. from the point of pruning, and for about 3·5 cm. up the silvered shoot. The discoloration was everywhere more extensive than the distribution of the hyphae; the latter occurred at the periphery of the wood, whence they could be traced inwards, branching in all directions and occasionally developing clamp connections (see Text Fig. 4).

From the above observations, it is evident, in this particular instance, where only one shoot out of many on the same bush and amongst other plants in the same bed became silvered, that the fungus had penetrated through a wound caused by pruning.

(6) **Neviusia alabamensis.**—During the late summer of 1918, a plant of this species growing at Kew, was noticed to be silvered. It was not examined until November, when a silvered plant was dug up, with its roots, for laboratory investigations. The root stock had suffered injury and was distinctly discoloured; a part

of it had already been killed. On splitting the shoot so as to expose the pith, it was noticed that the discoloration was found throughout the wood but it was most marked towards the pith.



Text fig. 4.—Longitudinal section of *Spiraea japonica* var. *glabrata*, showing hyphae in the wood.

The discoloration could be traced upwards to a point 90 cm. above the root stock, but the last 20 cm. of the shoot displayed no discoloration. Three other silvered shoots were cut off above ground, measuring from their point of last year's pruning, 140, 135, and 150 cms. respectively; curiously enough on splitting these shoots the discoloration was found to be absent from the base upwards to a height of 40, 45, and 63 cms. respectively; the browning then gradually increased in an upward direction towards last year's point of pruning. The absence of discoloration at the base of these three shoots suggests that the fungus had entered through the wounds caused by pruning.

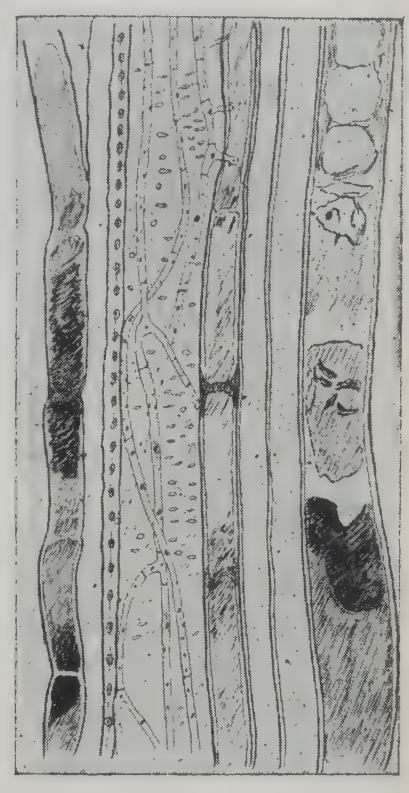
The nature of the discoloration of infected material varies within the tissues and according to the host. In the roots of *Neviusia* the discoloured cells assume various colours, from a purplish red to magenta, seldom a reddish brown (see Text Fig. 5). In the stem, the purple and magenta colour are replaced by a reddish pink, passing over to a dark brown. Abundant hyphae were present in the wood generally, but they were predominant in the xylem elements bordering the pith. (Text Fig. 6.) This is probably owing to the fact that there is greater aeration in the pith region. No hyphae were noticed beyond the discoloration, which proves that the fungus has penetrated in the one case through the injured root stock, and in the other three cases as a result of pruning.

(7) **Ribes cereum.**—While examining the bed of Portugal Laurel in Kew Gardens, already referred to, my attention was drawn to a plant of *Ribes cereum* growing about 26 ft. distant. On a single shrub four branches of the current year's growth exhibited silvering; one of these, a sucker, was taken to the laboratory. The remaining three shoots had developed at different heights from the ground; they were cut up into suitable

lengths for propagation and inserted, in order to see to what extent silvering may be transmitted by vegetative propagation.*

The discoloration in the wood was very slight and could only be seen with a pocket lens; it was traced for a distance of 18 cms. up the silvered sucker.

Text fig. 5.—Longitudinal section of root of *Neviusia alabamensis.*



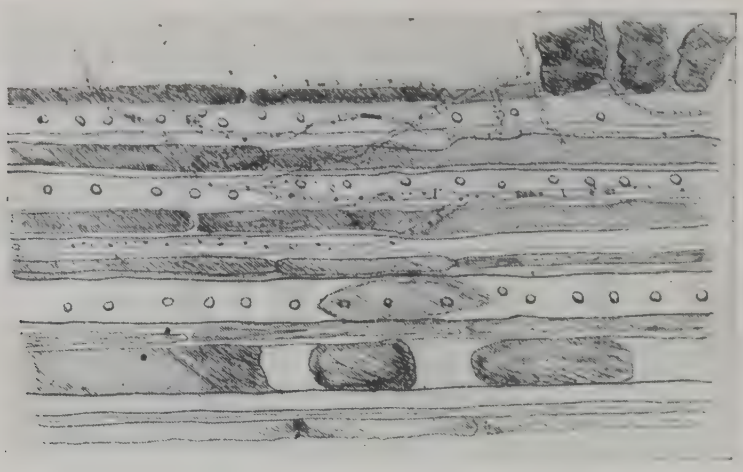
Text fig. 6.—Longitudinal section of a shoot of *Neviusia alabamensis.*

The hyphae were followed to within 2 cm. of the upper limit of the discoloured wood. In the silvered branches the inner wood elements are stained pink, passing over to bluish magenta towards the cambial region, whereas the cavities of the phloem and medullary rays cells are filled with a dark brown mass. Very few hyphae were seen in the central wood elements, but abundant threads were present in the elements bordering the cambial region (see Text Fig. 7). It was difficult to cut entire hand sections, as the xylem invariably separated from the bast; the cambial cells showed localised disorganisation as a result of the invading hyphae; the bast parenchyma also was somewhat affected and easily broke up, but no hyphae were observed in it.

The leaves were not examined and no fructifications of *Stereum purpureum* were noted anywhere on this partially silvered plant, but the characters of the hyphae were identical with those of other hosts, and those of mycelium grown in artificial cultures. Whether shoot as well as root infection took place in this plant cannot definitely be stated, but since browning could be traced from the root-stock into the lower part of the sucker only, it is certain that in this case the fungus gained entry through the injured root-stock.

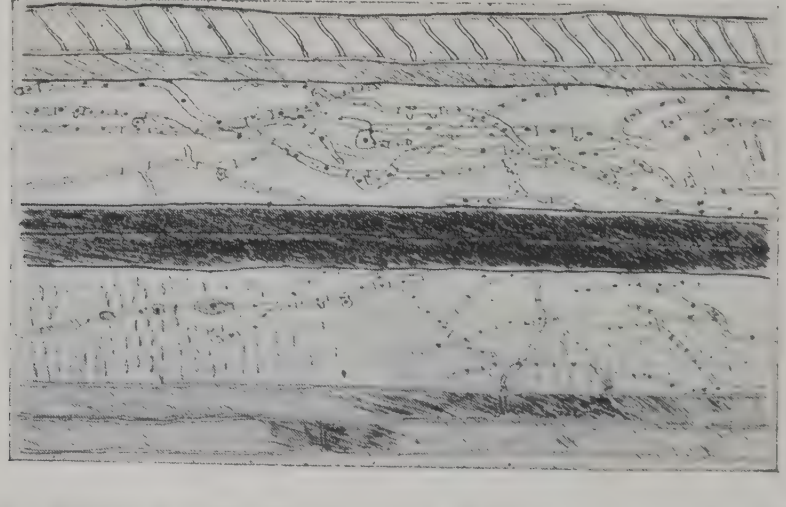
* 15 cuttings were inserted in a cold frame in the Royal Botanic Gardens, Kew, all of which have produced silvered shoots.

(8) **Laburnum vulgare** and **L. alpinum.**—The common Laburnum is mentioned by Güssow (12), Pickering (8), and Brooks (9), as having suffered from Silver leaf disease. Apart



Text fig. 7.—Longitudinal section through the wood of a shoot of *Ribes cereum.*

from the genus *Prunus* I have noticed no more extensive destruction on any other ornamental tree or shrub as a result of *Stereum purpureum* than on *Laburnum alpinum.* Judging from the damage caused during 1918 in the surburban district of London, where, in certain localities, up to 25 per cent. of the trees developed *S. purpureum* fructifications during autumn and winter, it is highly probable that unless drastic measures are taken the cultivation of *Laburnum alpinum* will become impossible. So far I have only met one case of a living tree of *Laburnum vulgare* bearing *S. purpureum* fructifications. A living side-branch of *L. vulgare* about four years old showed discoloration in the wood, a discoloration occupying about 100° of the circumference, but the extent gradually diminished upwards in the four and three year old wood. On reaching the two-year-old branches it was confined to the cambial region and to about one-third of the circumference, whereas in the one-year-



Text fig. 8.—Radial longitudinal section of the xylem vessels of *Laburnum vulgare* showing deep discoloration and abundant hyphae.

old twigs (current year's growth) it was reduced to a few continuous streaks.

Abundant hyphae were found growing in all directions in the wood elements (see Text Fig. 8), from the cambial region inwards. The hyphae present in the lumen of the vessels were in every respect identical with those observed in other hosts, already referred to, and similar to those grown in artificial cultures of *Stereum purpureum*.

There was no opportunity of examining the roots of *Laburnum vulgare*, and it is unknown if root infection took place. The fact that the upper set of branches of one half of the tree was killed by the fungus, whereas the lowest branches were apparently normal, indicates that the fungus penetrated through wounds in consequence of pruning, or through the abraded surfaces which frequently occur in the crown of the tree.

III.—Modes of Infection.

According to Percival (4), Güssow (12), Pickering (8), Brooks (9), the fungus *Stereum purpureum* is a wound parasite. In order to confirm this view several inoculation experiments were carried out in the laboratory. Pieces of mycelium, fructifications, and spores were placed on uninjured leaves of *Prunus lusitanica* in Petri dishes. Although the conditions for development of the fungus were most favourable, yet no invasion into the tissue could be observed. If, however, spores, pieces of fructifications and mycelium are laid on leaves which have been scratched with a needle or from which the epidermis has been removed, the penetration of the hyphae into the host soon begins, followed by partial disorganisation of the cells of the leaf. It is clear that the fungus if it can once gain entry can develop in the leaf, and it is hoped to carry out further experiments on this point.

Several plants of *Prunus lusitanica* were inoculated by placing pieces of mycelium of *S. purpureum* beneath the bark of stem, branches and roots. Within three weeks, discoloration of the cambial region of the wood appeared on both sides of the point of inoculation. In agreement with Brooks, I observed the rapid growth of the hyphae in an upward direction and a very slow progression down the shoot. Precisely the same process results from the insertion of pieces of fructifications or pieces of mycelium in the roots. In the control experiments no effect at all was obtained.

Stem and Branch Infection.—From the actual observations in the laboratory and in the field it would be premature to state at what particular time of the year infection takes place, since it is not yet known how long the spores retain their vitality. The following observation shows that they are capable of immediate germination. An old silvered branch of "Victoria Plum" was taken to the laboratory in October, and *S. purpureum* fructifications developed upon it within eight days from the day of amputation. Basidiospores taken from these fructifications germinated within 24 hours in hanging-drop cultures. Spores are undoubtedly blown about by the wind and possibly alight on

open wounds, where, under favourable atmospheric conditions, they germinate and penetrate the host.

Localised silvering of a branch or twig in any shrub or tree originates from local infection through unprotected wounds of branches and twigs. The spreading to other branches follows according to the progressive development of the hyphae inside the tissue; and since the hyphae grow more rapidly in an upward than in a downward direction, the silvering of the uppermost set of branches is explained, whereas the lower placed branches of the same tree may remain healthy for one or two seasons. The few cases known where healthy suckers come up from silvered trees are due to the fact that the hyphae have not yet passed to the root-stock or that the stock used for grafting may be less susceptible or even immune.

Root infection.—Many silvered suckers have been observed developing from normal plum-trees. It is common knowledge that Silver leaf on "Victoria" and other varieties of plums is more prevalent in plantations where the soil is cultivated for catch crops, than it is on grass land. This is probably due to the fact that while cultivating large plantations with a plough, or even a spade, it is difficult to avoid injury to superficial roots. Certain stocks, such as "Brompton" and "Common Plum," when used for grafting, send up every year numerous suckers, the removal of which causes additional injury. Other cases were noticed, where the lowest set of branches from the main stem showed silvering, while the upper branches were normal. No abrasion or jagged surfaces could be seen on any of the diseased branches. The removal of the lowest set of these silvered branches would by no means save the tree, since the discoloration extends to the main stem. A few cases were observed where silvered suckers arose from a plant, the upper parts of which were entirely normal. This strongly indicates root infection, probably through injury to superficial roots.

IV.—Preliminary Preventive Measures for True Silver Leaf.

Owing to the increase of Silver leaf the fruit-growing industry is seriously threatened, particularly with regard to our choice varieties of plums, *e.g.*, "Victoria" and "Czar," and soft cooking varieties of apples (already subjected to many other pests), "Lord Suffield," "Bramley's Seedling," "Lord Grosvenor," "Emperor Alexander," which are likely to go out of cultivation. The spreading of the disease to many ornamental trees and shrubs is also causing considerable alarm to growers. Prompt and drastic measures should therefore be taken to stamp it out.

In controlling plant disease one may adopt either curative or preventive measures. Unfortunately up to the present no practical *curative* measures with regard to Silver leaf are available. As a preventive measure all that one can recommend is good cultivation, using that expression in its widest sense

Careless pruning, unsatisfactory drainage and a deficiency of lime are especially to be avoided. The application of artificial fertilizers, particularly those of highly nitrogenous character, induces "soft" growth, with its greater liability to injury by frost and by insects. It is evident from the observations here put forward that those stone-fruit trees and other trees and shrubs annually subjected to pruning are much more likely to fall victims to Silver leaf than those which are not so treated. Indiscriminate pruning, and the cutting off of old branches for fire-wood, as was done in war-time, pave the way for the entrance of the fungus if the cut surfaces are not immediately treated.

The following primary preventive measures are recommended:—

1. The destruction of *Stereum purpureum* wherever it occurs, whether it is growing as a parasite or as a saprophyte.

2. If localised silvering in the upper set of branches of a tree is noticed, the silvered branches should be cut off without delay *below* the limit of discoloration of the wood. Many trees have been saved from total destruction where this method has been followed. Should, however, the lowest branches of a tree be affected, there is little hope of recovery, since the fungus is then present in the main stem. Such trees should be grubbed up before the fructifications develop, usually about September.

3. Whenever a branch is amputated, it is essential that the branch should be cut off as near as possible to the main stem or to the point of origin in order to encourage more rapid "callusing." A clean cut with a knife should follow the saw, especially where a jagged surface has been left. When pruning branches of the hosts mentioned on pp. 242, 243 of this paper, the cut surface should be protected immediately, thus preventing the spores of the fungus, which are blown about by the wind, from penetrating the host. Stockholm tar or its equivalent being one of the cheapest substances for protecting the wounded surface can be used for commercial purposes, whereas on a small scale, grafting-wax may be employed.

4. Removal of all dead and diseased wood from the plantation, since the fungus in the wood will soon develop fructifications, the spores from which are a great danger to the trees in the vicinity. Diseased branches should not be used for fencing, as this involves the same danger as when left in piles in the orchards. Storing of the wood under such dry conditions as prevent the development of the fungus should be aimed at. An alternative method, which may be adopted in large plantations, is the conversion of such cut off branches into charcoal in the field.

5. In plantations where the plough is used for catch crops, it is difficult to prevent injury to superficial roots, but additional injury by the spade may be minimised by a careful use of that implement, and by the pulling up of suckers.

6. Varieties of plums grown on their own roots produce only a few or scarcely any suckers, and hence the planting of such varieties is advisable whenever circumstances permit.

7. The planting of resistent or less susceptible varieties of

plum, such as "Yellow Pershore Plum" (sometimes called "Yellow Egg Plum") and "Early Rivers," is highly to be recommended.

8. The soft cooking varieties of Apples are more susceptible to Silver leaf than others, the latter should therefore preferably be planted.

9. Certain stocks, such as the "Brompton" and "Common Plum," are highly susceptible to this disease, whereas the "Yellow Pershore" is more or less resistent, and, in addition, possesses other valuable qualities.

10. Pruning of ornamental trees and shrubs known to be affected by this malady should be discontinued, unless the cut surfaces can be protected immediately after the operation.

11. When replanting infected orchards precautions should be taken to avoid the varieties of trees mentioned on page 242, since these varieties have proved susceptible to "true Silver leaf." An alternative to this is the interplanting in Plum orchards of Pear trees, or Cob-nuts and Filberts.

General Discussion.

The results described in the present contribution clearly support the view that *Stereum purpureum* is the main cause of Silver leaf. Cases of Silver leaf, however, are here described in which no trace of the fungus could be detected in any part of the plant.

It is suggested that silvering caused by *Stereum purpureum* should be called "True Silver leaf," and the term "False Silver leaf" be applied to those cases where the fungus is absent, the cause being apparently some physiological weakness.

In July, 1918, a plant of *Camellia Sasanqua* var. was observed in a pot in the Temperate House, Kew Gardens, which exhibited marked silvering of the leaves. The roots, branches, and twigs of this plant were examined, but no trace of hyphae were found. Local discoloration in the cells of the various tissues was observed here and there, but a continuous streak was never perceptible. Hand and microtome sections, both longitudinal and transverse, of petioles and leaves, failed to reveal any fungal threads. In hand sections no separation of the tissues occurred, indicating that there had been no dissolution of the middle lamella. In comparison with normal leaves, a waxy deposit of the colour of white lead is secreted by the affected leaves, and this gives a silvery appearance when the leaves are seen from a distance. There was also a reduction of chloroplasts in these leaves as compared with the healthy ones.

"False Silver leaf" is also to be found on a few varieties of Apples, the variety "Grenadier," already mentioned, and "Bramley's Seedling." It has also been observed on *Koelreuteria paniculata*, Saxm., on cultivated varieties of Cherries, Peaches and Plums. False Silver leaf is probably due to some physiological disturbance of the plants, possibly induced by unsuitable treatment. Plants of *Koelreuteria* which showed this false Silver leaf during one or two seasons, were observed to regain their normal colour under improved cultural treatment.

Silvering is more common, according to my observations, where the drainage is bad and where there is a deficiency of lime in the soil. If the trees are top-grafted on an unsuitable stock, the chances of the occurence of false Silver leaf appear to be increased.

The following table indicates the distinction between true and false Silver leaf:—

True Silver Leaf. (Cause.—*Stereum purpureum.*)	False Silver Leaf. (Cause.—Physiological Weakness?)
1. Easy separation of the tissues of the leaf, resulting from the dissolution of the middle lamella; usually no reduction in the number of chloroplasts.	1. No separation of the tissues of the leaf; the chlorophyll is reduced in amount.
2. Discoloration present in the xylem or other tissues of the branches, stem and roots, appearing as continuous streaks, very seldom in scattered patches.	2. No regular discoloration in the stem, but it may occur as small localised areas, never in continuous streaks.
3. Branches placed in water for 48 hours discolour the water after 48 hours. In those cases where normal branches discolour the water, the coloration is different in the case of diseased branches.	3. Branches placed in water for 48 hours do not discolour the water as compared with normal branches.
4. Fungal hyphae always present in the stem or root, but so far not discovered in the leaves.	4. No fungal hyphae in any tissue of the plant.

It should be noted that it does not necessarily follow that in every part of a true silvered plant all four distinguishing characters would be met with. When dealing with plants which in normal conditions discolour water, care must be exercised that branches or twigs of equal size are taken and the capacity of the vessel considered.

As far as published evidence goes, no mention has been made of "False Silver leaf" by any writer on the subject. Brooks, however, observed a plant of *Lamium album* exhibiting Silver leaf with a shrivelled epidermis, which could easily be separated from the mesophyll cells, but he concluded that the silvering in this case could not be attributed to *Stereum purpureum*. Brooks also draws attention in his second paper to the confusion of Silver leaf with Chlorosis when dealing with applications of iron compounds to restore normal growth. It is therefore very difficult to comment on the work of those who hold the physiological theory of the cause of Silver leaf, but according to the work of Prillieux (1), Sorauer (2), Alderhold (3), and Massee (5), it is obvious from their descriptions that they were dealing with *True* Silver leaf, although these writers invariably interpreted the disease as of non-parasitic nature. A considerable amount of material is required for successful investigation, particularly fair-sized twigs and branches, since the hyphae only in extreme cases approach the terminal bud of the current year's growth.

The fact that no hyphae are to be found in the leaves of plants suffering from True Silver leaf has no doubt led these authors to the non-pathogenic theory of the disease. At that time also the fungus *Stereum purpureum* was considered a saprophyte, and it is apparently only during recent years that its virulence as a parasite has increased and has spread to plants belonging to various natural orders. In the case of *Neviusia alabamensis* and *Spiraea japonica* var. *glabrata*, described here, the hyphae would have certainly been overlooked, if the examination had been confined to the apical shoots.

In addition to the literature on Silver leaf mentioned in this paper I have been unable to find any evidence as to bacteria being the cause of Silver leaf, as referred to by Blackmore (7), in his report. It is obvious that soil and atmospheric conditions or other environmental factors of a greenhouse are capable of causing physiological injury to the plant, but up to the present there is no evidence indicating parasitic bacteria as the cause of either *True* or *False* Silver leaf.

It is interesting to note that the partial disorganisation of a tissue, as a result of the dissolution of the middle lamella, in which fungal hyphae are not present—which is normal to the leaves of silvered plants—is also found in the silvered *twigs* of *Prunus triloba*, var. *flore pleno*. There the bast shows partial disorganisation, although the hyphae are confined to the cambial region.

Since enzymes are apparently colloidal substances which would diffuse with difficulty through cell-walls; the most satisfactory explanation of the changes in the leaf, seems to be the one suggested to me by Professor V. H. Blackman, that some diffusible poisonous substance is produced during the metabolic processes of the fungus or of the invaded cells of the host; this substance is then conveyed to the leaves by the water conducting channels, where it causes a change in the activity of the enzymes capable of acting on the middle lamella of the wall. A similar reaction apparently takes place in the bast of *Prunus triloba* var. *flore pleno*.

In the experiments already described where pieces of mycelium, or fructifications or spores, were placed on injured leaves of *Prunus lusitanica* in petri dishes, the hyphae were found to have penetrated the leaves in about 12 days, without, however, causing a falling asunder of the tissues. The dissolution of the middle lamella therefore does not seem to be due to direct action of the fungus, at least in its early stages, but rather to the result of the interaction of the metabolisms of the fungus and bast cells of the twig. Whether infection can also take place in nature in injured leaves is yet unknown.

The appearance of the discoloration varies with the different host plants. In all the cases examined, the discoloration of the host tissue extended beyond the limit of the hyphae. Brooks' observations on the discoloured wood of plum trees were confirmed by placing pieces of the fructifications or ordinary mycelium from artificial cultures on sterilized blocks of plum wood. In four days a definite discoloration of the wood was to be observed; when

three weeks later the block of wood was examined no hyphae could be found towards the edge of the discoloured area. To avoid confusion between the discoloration produced by the fungus and that resulting from oxidases, the material was steeped in boiling water for ten minutes before being cut into sections.

With regard to the general characteristics of *Stereum purpureum*, it was found that this fungus varies considerably in colour and in external characters. It differs apparently according to whether it has been growing parasitically or purely saprophytically, for the fructifications on *Salix* have distinctly smaller spores than those on Plum and Apple. However, for the present, the fungus must be treated as a single polymorphic species, as only definite evidence afforded by a series of careful investigations would justify the division of the species into distinct forms. *S. purpureum* is found growing as a saprophyte on the dead wood of the following genera: *Betula, Corylus, Fagus, Ulmus, Genista, Salix*, etc. There can be no question that the fungus was less detrimental in past years, and it is only during the last twenty years that its virulence has gradually increased to such an extent that the disease is now of almost epidemic nature. Whether the purely saprophytic form of *S. purpureum* growing on the hosts mentioned above are able to cause "Silver leaf" remains to be proved,* but it is certain that mycelium or pieces of fructifications from *Betula, Genista* and *Salix* when inoculated into Plum and Apple trees will cause discoloration of the wood, indicating that the hyphae have developed in the tissues.

The fungus can apparently only enter a living plant by open wounds, and is capable of attacking a great number of woody species, belonging to various natural orders, infection taking place both through the stems and superficial roots. It is facilitated by pruning, particularly when the wounds are left *unprotected*, and also by any mechanical injury of an exposed part of the tree, or as a result of injury to superficial roots.

With regard to the distribution of mycelium, no hyphae have been detected in the lamina or petiole of leaves in any "silvered" plant, either by the author or any previous workers. In the bast of affected twigs of *Prunus triloba* var. *flore pleno*, abnormal air spaces are to be found, and a dissolution of the middle lamella which leads to a falling asunder of the tissues, similar to that found in the leaves of plums. No hyphae, however, were observed. It is evident therefore that under some circumstances the fungus is able to exert in the stem the same injurious action at a distance which is common in the leaf.

VI.—Summary and Conclusions.

The present investigations lead to the conclusion that there are two types of Silver leaf, namely, (1) *True Silver leaf*, by far

* The inoculation experiments which are in progress at the Royal Horticultural Society Gardens, Wisley, definitely prove that the forms of *S. purpureum* found growing as a pure saprophyte are capable of producing Silver leaf, and with the same virulence upon various host-plants as those of *S. purpureum* growing parasitically.

the most common, and caused by the fungus *Stereum purpureum*, and (2) *False Silver leaf*, which is comparatively rare, and due apparently to the result of some physiological weakness. It is difficult to distinguish the two forms by external examination, as the appearance of the foliage is practically identical. *True Silver leaf* however is characterised by a dark discoloration of the wood when seen in cross-section, and a ready peeling off of the upper epidermis of the leaf.

The principal features of the *True Silver leaf* are as follows: The normal green colour is hidden by the presence of air spaces under the cuticle, which causes a reflection of the light, and brings about the silvery appearance. There is usually no reduction in the number of chloroplasts. As a result of the dissolution of the middle lamella of the cell walls of the leaf, the leaf tissues easily fall apart when the leaf is sectioned. The dissolution of the middle lamella is perhaps brought about by the production of some diffusible poisonous substance during the metabolic process of the fungus and of the invaded cells of the host; this substance is then conveyed to the leaves by the water conducting channels, where it causes a change in the enzymes capable of dissolving the pectic substances of the cell-wall. Affected plants moreover nearly always show continuous streaks of dark brown discoloration in the woody tissues of the stem, branches, twigs or roots, which when examined microscopically, reveal the presence of exceeding fine filaments of *S. purpureum*. Branches suffering from *True Silver leaf*, when placed in water for 48 hours cause the discoloration of the water, the degree of discoloration depending on the severity of the attack.

Initial infection takes place above ground and also immediately below the ground level, and so far as the present investigations are concerned, the fungus can only gain entrance through open wounds. Recent inoculation experiments (the results of which will be published later) confirm the view that injured superficial roots can be infected; the frequency of infection probably depends on the variety of the stock used for grafting. Localised silvering of a branch results from local infection, which has not yet spread to the main stem. Silvered suckers originating from a healthy tree indicate root infection, whereas the occurence of healthy suckers from diseased plants points to crown or stem infection, since the mycelium has not yet reached the root system. The following plants have been examined, all of which suffered from *True Silver leaf*: "Victoria Plum" (and the stocks upon which it is usually grafted, *e.g.*, the "Brompton" and "Common Plum"), *Prunus lusitanica*, *P. triloba* var. *flore pleno*, among Apples the varieties "Lord Grosvenor" and "Bramley's Seedling," *Spiraea japonica* var. *glabrata*, *Neviusia alabamensis*, *Ribes cereum*, *Laburnum alpinum and L. vulgare*. Although fructifications of *S. purpureum* have not been noticed in *Ribes cereum* and *Spiraea japonica* var. *glabrata*, yet the hyphae observed in the tissues were identical with the hyphae of that fungus grown in artificial cultures. In view of the frequency and the disastrous effects of *True Silver leaf*, and its increasing world-wide importance, the author of this paper recommends the ex-

termination of *Stereum purpureum* wherever it occurs. This is further advisable since it is known that the saprophytic forms have the same injurious effect when inoculated into living trees as those found parasitically. Preliminary measures of a preventive nature are described.

False Silver leaf is much less prevalent than *True Silver leaf*. It is easily distinguished by certain microscopic characters. The leaves show a reduction in chloroplasts, which gives them a silver-lead colour from a distance; there is however, no dissolution of the middle lamella, and no falling apart of the cells. No hyphae have been observed in any part of a diseased plant. There are no continuous streaks of discoloration to be observed in the wood, and cut-branches do not discolour the water when placed in it. The former is perhaps the only reliable "field" character. *False Silver leaf* is occasionally found in apples, "Grenadier," "Bramley's Seedling," *Camellia Sasanqua* var., *Koelreuteria paniculata*, and rarely on cultivated varieties of Cherries, Peaches and Plums. Trees and shrubs which have suffered from *False Silver leaf* for one or two seasons have been noted to resume their normal appearance the following year when improved cultural treatment has been applied.

The microscopic examinations and the primary preparations for the inoculation experiments were carried out under the personal supervision of Prof. V. H. Blackman, to whom I am much indebted for assistance and valuable suggestions in many directions.

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Explanation of Text Figures.

All the figures have been reduced by one half for reproduction.

1. Longitudinal section through the wood of a silvered sucker of "Brompton Stock," showing hyphae of *S. purpureum* in a vessel, with two distinct clamp connections. × 1000 times.
2. Longitudinal section through the wood of *Prunus triloba* var. *flore pleno*, showing hyphae of *S. purpureum* in the xylem vessels bordering the cambium. In one case the hyphae pass through the discoloured area. The cambium cells have fallen apart. × 1000 times.
3. Longitudinal section through the wood of a silvered Apple (said to be "Bramley's Seedling"), showing abundant hyphae in the wood vessels, with numerous clamp connections. The hyphae are unusually irregular in form. × 1000 times.
4. Longitudinal section of a silvered branch of *Spiraea japonica* var. *glabrata*, showing the hyphae in the wood vessels. × 1000 times.
5. Longitudinal section of a diseased root of *Neviusia alabamensis*, showing presence of hyphae and alternate discoloration of the cells. × 1000 times.
6. Longitudinal section of a silvered shoot of *Neviusia alabamensis*, with hyphae in the xylem vessels. × 1000 times.
7. Longitudinal section of a silvered shoot of *Ribes cereum*, showing the hyphae and pronounced discoloration in the wood vessels. × 1000 times.
8. Radial longitudinal section of the xylem vessels of *Laburnum vulgare*, showing deep discoloration and abundant hyphae of *S. purpureum*. × 1000 times.

Description of Plate VIII.

Fig. 1. A sterilized block of Plum wood upon which a piece of *Stereum purpureum* had been placed. The figure shows that the discoloration extends beyond the region of the hyphae; (1) indicating the extent of the discoloration, (2) the limit of hyphae, and (3) the portion of fructification placed on the wood.

,, 2. Branch of *Prunus lusitanica*, showing silvering and curling of the leaves. The letter x indicates that the upper epidermis has been detached from the palisade cells.

Fig. 3. A sucker of "Common Plum" stock, showing parallel, sometimes tortuous streaks of discoloration.

,, 4. Fructifications of *S. purpureum* growing on a living branch of *Prunus triloba* var. *flore pleno*.

,, 5. Fructifications of *S. purpureum* growing on a living branch of Apple tree said to be "Bramley's Seedling."

XVII.—DIAGNOSES AFRICANAE: LXXII.

1631. Kalanchoe densiflora, *Rolfe* [Crassulaceae]; affinis *K. crenatae*, Harv., sed floribus minoribus et cymis densioribus distincta.

Herba succulenta, erecta, glabra, 0·5-1·1 m. alta. *Caulis* simplex, strictus, crassiusculus, subteres. *Folia* opposita, petiolata, ovata, obtusa, crenata, viridia, 7-10 cm. longa, 6-7·5 cm. lata; petioli circiter 1 cm. longi. *Cymae* pedunculatae, erectae, 3-5 cm. latae, densiflorae, in paniculam corymbosam 10-12 cm. latam dispositae. *Bracteae* lineares, acutae, 4-5 mm. longae. *Pedicelli* circiter 3 mm. longi. *Calyx* 4-partitus, 5 mm. longus; lobi subulati, acuti, 5-6 mm. longi. *Corollae* tubus 1 cm. longus, basi ventricosus, superne tubulosus; lobi ovati, apiculati, 3 mm. longi, flavi, margine incurvi. *Stamina* inclusa.

Tropical Africa. British East Africa: Limuru, 2250 m., in short grass and bushland, *J. D. Snowden* 556. Said to be erect or nearly so, 2 to 4 ft. high, and with yellow or reddish flowers.

1632. Anisophyllaea tomentosa, *Rolfe* [Rhizophoraceae]; affinis *A. fruticulosae*, Engl. et Gilg., sed major et foliis fere duplo longioribus differt.

Ramosissima, ramis juvenilibus dense ferrugineo-tomentosis, vetustis cinereis et striolatis. *Folia* breviter petiolata, elliptica vel ovato-elliptica, obtusa vel subobtusa, basi cuneata, coriacea, primo dense ferrugineo-tomentosa, supra mox subglabra, subtus tomentosa, 5-8 cm. longa, 2-4·5 cm. lata, 5-nervia, jugis 2 lateralibus prominentibus arcuatis et fere ad apicem extensis, venis reticulatis; petioli circiter 5 mm. longi. *Spicae* axillares, numerosae, ferrugineo-tomentosae, 5-8 cm. longae. *Flores* sessiles, numerosi, globosi, ferrugineo-tomentosi. *Sepala* late ovata, 1-1·5 mm. longa. *Petala* 1·5-2 mm. longa, basi oblonga, apice in laciniis filiformibus profunde fissa, lobis involutis. *Fructus* ellipsoideus, sulcatus, circiter 2·3 cm. longus, 1·3 cm. latus.

Tropical Africa. Angola: Malange district, *Gossweiler* 1395, 1396; Bailundo district, Benguella, 1530 m., *Wellman*. Belgian Congo: at Katanga, *Ringoet* 56. Native name, "*Mufungo*."

1633. Scyphosyce pandurata, *Hutchinson* [Moraceae]; affinis *S. Mannianae*, Baill., sed ramulis glabris cortice brunneo transverse rupto, foliis e medio ad basin abrupte angustatis superne late ovatis et sensim acuminatis differt.

Ramuli graciles, glabri, cortice sulcato transverse rupto. *Folia* pandurata, parte superiore late ovata et sensim obtuse acuminata, basi e medio abrupte angustata, 10-13 cm. longa, 4-5 cm. lata, chartacea, integra, supra pallide viridia, infra pallidiora, utrinque glabra; nervi laterales utrinsecus circiter 10, a costa media angulo lato abeuntes, intra marginem arcuati et conjuncti; venae infra laxae, stramineae; petioli 4-6 mm. longi, curvati, glabri; stipulae persistentes, lanceolatae, acute acuminatae, 6 mm. longae, 3 mm. latae, submembranaceae, sicco purpureo-brunneae, glabrae. *Receptacula* axillaria, solitaria, pedunculata, ellipsoideo-obconica, circiter 4 mm. longa, glabra; pedunculi 5-8 mm. longi, minute puberuli. *Antherae* e receptaculo exsertae, vix 1 mm. longae.

Tropical Africa. Southern Nigeria: Oban, *Talbot* 1315, 2317.

1634. Kniphofia Snowdeni, *C. H. Wright* [Liliaceae-Hemerocalleae]; a *K. longistyla,* Baker, perianthio pubescente differt.

Folia linearia, 1 cm. lata, glabra, circiter 15-nervia, integra, marginibus hyalinis. *Pedunculus* 30 cm. altus, cylindricus; spica 25 cm. longa; bracteae ovatae, longe acuminatae, 5 mm. longae. *Perianthium* 2·3 cm. longum, leviter curvatum, supra ovarium constrictum, extus pubescens, costis validis instructum, rubrum vel luteum; lobi rotundati, obtusi, 2 mm. longi et lati. *Antherae* inclusae. *Ovarium* conicum; stylus triquetrus, demum exsertus.

Tropical Africa. Uganda: Mount Elgon, 2440-3060 m., in short grass and small bush land, *J. D. Snowden* 437.

1635. Eriocaulon recurvifolium, *C. H. Wright* [Eriocaulaceae]; *E. Hanningtoni,* N. E. Br., affinis, pedunculis obtuse triangularibus pilosis differt.

Acaulescens. *Folia* plura, rosulatim disposita, subulata, recurvata, 1·2 cm. longa, 0·4 mm. lata, subtus incana, supra parte basali pubescentia, parte superiore verruculosa. *Pedunculus* obtuse triangularis, pilosus, usque ad 13 cm. longus; vagina 1·5 cm. longa, acute 2-dentata, glabra; receptaculum pedicellique pilis sericeis 2 mm. longis vestita; bracteae late ovatae, quam flores breviores, glabrae. *Flos* ♂:—*Sepala* 3, uniformia, ovato-lanceolata, 1 mm. longa, acuminata, subtus hyalina, supra dilute brunnea, sparse ciliata. *Petala* nulla. *Filamenta* connata; antherae 6, subglobosae, albae. Flos ♀:—*Sepala* 3, lanceolata, acuta, concava, curvata, 3 mm. longa. *Petala* 3, obcuneata, 1·5 mm. longa, obtusa, sparse ciliata, eglandulosa. *Ovarium* breviter stipitatum, oblongo-ovoideum, 3-loculare; stylus ovario paullo longior, apice penicillatus.

Tropical Africa. Belgian Congo: Atené, January, 1914, *H. Vanderyst,* 3133.

1636. Brachiaria nana, *Stapf* [Gramineae-Paniceae]; *B. ramosae,* Stapf, affinis, sed habitu nano, spiculis minoribus laevissimis, anthoecio infero valvula destituto distincta.

Annua (semper ?), 3-5 cm. alta, caespitosa. *Culmi* primarii prostrati, subgraciles, multinodi, radicantes, apice adscendentes, dense foliosi, ramosi, internodiis 3-6 mm. longis ob vaginas emarcidas evanescentes tandem denudatis glabris vel minute puberulis, nodis annulatim incrassatis; rami vel culmi secundarii similes, nisi breviores (vel brevissimi), sub anthesi crebre ramulosi ramulis floriferis, ramis ramulisque dense fasciculatis. *Foliorum* vaginae pallidae, subscariosae vel superiores subherbaceae, praeter margines dense ciliatos glabrae laevesque vel parce minute pubescentes; ligulae ad marginem ciliatum reductae; laminae e basi rotundata vel subcordata lanceolatae, acutae, 1-1·5 cm. longae, 3-5 mm. latae, rigidulae margine conspicue cartilagineo scaberulo, pallide virides, glaberrimae vel parce pubescentes, supra dense tenuiter multinerves, subtus nervis primariis 3-5 distinctis. *Paniculae* folia summa haud vel vix excedentes, 1·2-2 cm. longae, ramis perpaucis suberectis vel ad racemum simplicem redactae; axis primaria, ut racemorum rhachis et pedicelli, glabra, ad angulos scabra; rhachis triquetra, circiter 0·4 mm. lata, internodiis 1-1·5 mm. longis; pedicelli praeter summum brevissimi, solitarii. *Spiculae* ovato-lanceolatae vel oblongae, acutae, circiter 2·25 mm. longae, pallide virescentes vel purpureo-suffusae, laevissimae. *Gluma* inferior perlate ovata, subacuta, hyalina, obscure 3-nervis, trientem spiculae aequans, superior ambitu spiculae, tenuiter 7-nervis. *Anthoecium inferum* ad valvam glumae superiori simillimam sed 5-nervem reductum. *Anthoecium superum* ♀ ambitu elliptico-oblongum, subacutum, 1·6 mm. longum, albidum, valva valvulaque tenuissime rugulosis; antherae 0·8 mm. longae.

Madagascar. Dry plains near Onilahy, *Perrier de la Bathie* 107.

Barren specimens of what is probably the same species were collected by Dr. Coppinger on Cerf Island, Providence Reef, North of Madagascar. They exhibit the same mode of growth, but the leaf-blades are much less rigid, narrowed towards the base, always quite glabrous and up to 3·5 cm. by 5-7 mm. The tufts are 5-7 cm. high. The affinity with *B. ramosa* is quite clear and one might consider the species described here as an extremely stunted condition of it if it were not for the smaller, narrower, and very smooth spikelets and their more reduced lower floret.

1637. Panicum uvulatum, *Stapf*, [Gramineae-Paniceae]; inter species gregis *P. parvifolii*, Lam., spiculis ad apices paniculae ramorum longorum tenuiter filiformium dense congestis distinctum.

Perenne (?). *Culmi* pergraciles, multinodi, e basi saepe longe vagante radicante adscendentes, ramosi, ramis partis prostratae culmos secundarios primariorum indole referentibus, internodiis 1·5-3 cm. longis laevissimis inferioribus demum denudatis. *Foliorum* vaginae arctae, tenuiter striatae, 1-2 cm. longae, ad os barbulatae et superne ad margines ciliolatae, caeterum glabrae, rarius tenuissime parce pubescentes vel ad nodos pilosae, inferiores demum emarcidae et delabentes; ligulae brevissimae,

rotundatae, hyalinae; laminae lanceolatae vel lineari-lanceolatae, basi breviter contractae, apicem versus longiuscule attenuatae, acutissimae, 2-4 cm. longae, 3-7 mm. latae, oblique patentes, planae, tenues, glaberrimae, ad margines scaberulae vel sublaeves, nervo medio tenui subtus albido, lateralibus crebris tenuissimis primariis (utrinque 3) vix distinctis. *Inflorescentia* foliata, e panicula terminali et pluribus (ad 5) lateralibus e foliorum normalium axillis ortis composita, gracillima; paniculae laterales inferiores pedunculo tenuiter filiformi 5-7 cm. longo suffultae, ramis primariis 3-1 remotis; ramus infimus saepe longiusculus, valde divergens (inde panicula quasi furcata) inferne plerumque longe indivisus, tunc quasi bifidus, ramulum subaequilongum edens, ramo ramuloque apice iterum divisis et ibi spiculigeris, spiculis in glomerulos uviformes 7-4 mm. longos ovoideos congestis; rami sequentes similes nisi parte indivisa breviore vel brevissima vel nulla et tunc quasi trifidi; panicula terminalis lateralibus similis sed ramis sursum magis gradatim abbreviatis minusque divergentibus; pedicelli tenuissimi, ad 1 mm. longi, laeves, apice obscure discoideo-dilatati. *Spiculae* oblongae vel elliptico-oblongae, acutae, 1·5 mm. longae, viridulae, glaberrimae. *Glumae* dissimiles, tenuiter subherbaceo-membranaceae; inferior ovata, acuta, basi amplectens, 1-nervis, circiter 2/5 spiculae aequans, superior ambitu spiculae, vel paulo brevior, 3-sub-5-nervis. *Anthoecium inferum* ad valvam glumae superiori similem 5-nervem reductum. *Anthoecium superum* ♀, elliptico-oblongum, subacutum, 1·3 mm. longum; valva valvulaque tenuiter crustaceae, laevissimae, nitidae, pallide olivaceo-virides.

Madagascar. Between Tamatave and Antananarivo, *Meller*. Central Madagascar, without precise locality, *Baron* 660, 4099. Twohimanitra forest, *Forsyth Major* 91; basin of the Makitana river, *Perrier de la Bathie* 68 bis.

1638. Panicum epacridifolum, *Stapf* [Gramineae-Paniceae]; affine *P. parvifolio*, Lam., habitu, inflorescentiae depauperatae ramis patulis brevibus 2-1-spiculatis, spiculis paulo majoribus, glumis minute nigro-verrucosis distinctum.

Perenne ? Culmi prostrati, graciles, radicantes vel arcuati (penduli ?), dorsiventrales, permultinodi, ad 15 cm. longi, ramosi, per totam longitudinem vaginati, nisi in inferiore parte ob vaginas ramis evolutis repulsas hinc inde denudati, glabri. *Foliorum* vaginae firmulae, striatae, molliter hirsutae, subarctae, 4-5 mm. longae; ligulae ad marginem ciliolatum reductae; laminae secundae, ovato-lanceolatae, acutissimae, subpungentes, 6-7 mm. longae, 3 mm. latae, rigidae, striatae, hirsutae. *Paniculae* plerumque ramos ad 6 cm. longos terminantes, magis minusve exsertae, circiter 2 cm. longae, axi primario ut ramis 2-4 patulis vel subdeflexis, 4-1 mm. longis 2-1-spiculatis glabro, tenuiter angulato; pedicelli ramorum laterales si adsunt breves vel perbreves, terminales 3-4 mm. longi. *Spiculae* luride virides, ovato-vel oblongo-lanceolatae, acutae, circiter 2 mm. longae, glabrae. *Glumae* inaequales, tenuiter subherbaceae, verrucis saepe atris minutis magis minusve conspersae; inferior

late ovato-elliptica, acuta, ultra 0·5 mm. longa, distincte 3-nervis, superior longitudine spiculae, 5-nervis. *Anthoecium inferum* ad valvam glumae superiori persimilem redactum. *Anthoecium superum* ♀, elliptico-vel oblongo-ovatum, acutum, 1·7 mm. longum, olivaceum, laevissimum, nitidum; valva valvulaque crustaceae, haec colore magis saturato. *Antherae* 0·8 mm. longae.

Madagascar. On rocks near Antsirabe, 2000 m., *Perrier de la Bathie*. Central Madagascar, without precise locality, *Baron* 4318.

1639. Panicum bambusiusculum, *Stapf* [Gramineae-Paniceae]; affine *P. parvifolio*, Lam., sed habitu, spiculis hirsutiusculis, gluma inferiore spiculam subaequante distinctum.

Perennae, ut videtur, vagans, teste collectore 1-2 m. altum. *Culmi* teretes, ad 1·5 cm. diametro, laevissimi, e nodis hincinde radicantes, internodiis ad 7 cm. longis purpurascentibus, denudati, ramosi, ramis primariis vel secundariis a basi saepe copiose iteratim ramulosi, ramulis in fasciculos collectis; ramuli multinodes, graciles, ad 6 vel interdum 8 cm. longi, per totam longitudinem vaginati, vel inferne ob vaginas repulsas denudati, internodiis demum 7-5 mm. longis. *Foliorum* vaginae culmorum et ramorum primariorum arctae, tenuiter striatae, laeves, praeter margines ciliolatos glabrae, 2·5-1·5 cm. longae, ramulorum ad margines longe ciliatae, 8-7 mm. longae; ligulae ad marginem tenuissimum glabrum redactae; laminae culmorum ovato-lanceolatae vel lanceolato-lineares, semper basi rotundatae vel subcordatae et semi-amplexicaules, tenuiter acuminatae, 6-2 cm. longae, 7-5 mm. latae, firmulae, florendi tempore emarcidae, glabrae, tenuiter multinerviae, ramulorum multo minores, 1-10 mm. longae, 3·5-3 mm. latae, rigidulae, ad margines e tuberculis minutis longe ciliatae, caeterum glabrae vel parce pilosae, nervis approximatis, venulis transversis brevissimis prominulis. *Panicula* ambitu ovata, 2-1·5 cm. longa, ad 1 cm. lata; axis uti rami ramulique superne undulato-flexuosus, glaber, laevis; rami ramulique obliqui, graciles vel gracillimi; pedicelli 1·5-2 mm. longi, apice minute discoidei. *Spiculae* lanceolato-oblongae, acute acuminatae, ad 1·8 mm. longae, luridae vel pallide virides. *Glumae* similes, tenuiter subherbaceae, tuberculato-hirsutulae, inferior paulo minor, 3-nervis, superior 5-nervis. *Anthoecium inferum* ♂; valva glumae superiori simillima; antherae 0·8 mm. longae. *Anthoecium superum* ♀, ellipticum, acutiusculum, 1·2 mm. longum, albidum, laevissimum.

Madagascar. Without precise locality, *Gerrard* 75.

1640. Rutenbergia Usagarae, *H. N. Dixon* [Musci-Rutenbergicae]; *R. borbonica*, Besch., cui proxima, differt habitu robustiore, foliis longioribus frondem latiorem instruentibus, caulibus inferne haud defoliatis, costa multo angustiore, cellulis pellucidis. A *R. madagassa*, Geh. et Hpe. habitu alieno multo laxiore robustiore, foliis medio leniter longitudinaliter plicatis, nec transverse corrugatis, marginibus fortius serrulatis.

Tropical Africa. Usagara: Itumba, on woody branches, *Rev. A. North Wood*.

XVIII.—BOTANICAL RESULTS OF SWEDISH SOUTH AMERICAN AND ANTARCTIC EXPEDITIONS.

W. B. Turrill.

The appearance of Dr. Skottsberg's final publication resulting from the Swedish Expedition to Patagonia and Fuegia, 1907-1909, gives a good opportunity for summarizing the recent botanical work of Swedish botanists in the southern part of the American continent and its neighbouring islands, in the Antarctic, and in certain of the subantarctic islands. Their work is of special interest to British botanists for two reasons. In the first place the Falklands and South Georgia are included in the British Empire, and secondly, some of the areas visited by the Swedish expeditions were made classical by the researches of Darwin, Hooker, and others of our countrymen, who were the first to suggest solutions to many of the problems again attacked in the series of books and papers here reviewed. These chiefly record the results obtained during two expeditions to the Southern Hemisphere. The one, known as the "Swedish South Polar (or Antarctic) Expedition," was under the leadership of Nordenskjöld, and took place between the years 1901 and 1903; the second, with the title "Swedish Expedition to Patagonia and Fuegia," was arranged by Dr. Skottsberg, and lasted from 1907 to 1909.

The following bibliographical list gives the publications dealing with the botany of these two expeditions:—

(1) Skottsberg, "The Geographical Distribution of Vegetation in South Georgia." Geogr. Journ. Nov. 1902, p. 498.

(2) Skottsberg, "On the Zonal Distribution of South Atlantic and Antarctic Vegetation." Georgr. Journ. Dec. 1904, p. 655.

(3) Stephani, "Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901-1903." Band IV. Lief. 1 (1905). "Hepaticae."

(4) Skottsberg, Ibid. Lief. 2 (1905). "Feuerländische Blüten."

(5) Skottsberg, Ibid. Lief. 3 (1905). "Die Gefässpflanzen Südgeorgiens."

(6) Skottsberg, Ibid. Lief. 4 (1906). "Zur Flora des Feuerlandes."

(7) Foslie, Ibid. Lief. 5 (1907). "Antarctic and Subantarctic Corallinaceae."

(8) Skottsberg, Ibid. Lief. 6 (1907). "Zur Kenntnis der subantarktischen und antarktischen Meeresalgen."

(9) Ekelöf, Ibid. Lief. 7 (1908). "Bakteriologische Studien."

(10) Cardot, Ibid. Lief. 8 (1908). "La flore Bryologique des Terres Magellaniques, de la Georgie du Sud et de l'Antarctide."

(11) Skottsberg, Ibid. Lief. 9 (1909). "Pflanzenphysiognomische Beobachtungen aus dem Feuerlande."

(12) Skottsberg, Ibid. Lief. 10 (1909). "Studien über das Pflanzenleben der Falklandinseln."
(13) Darbishire, Ibid. Lief. 11 (1912). "The Lichens."
(14) Skottsberg, Ibid. Lief. 12 (1912). "The Vegetation of South Georgia."
(15) Skottsberg, Ibid. Lief. 13. (1912). "Die Vegetationsverhältnisse des Graham Landes."
(16) Cardot, "Notice Prélim. sur les Mousses," Bull. Herb. Boiss. 2nd. sér. V. 1905, p. 997, and l.c. VI. 1906, p. 1.
(17) Skottsberg, "Swedish Magellanian Expedition 1907-1909," Preliminary Reports, Georgr. Journ. June 1908, p. 640; Nov. 1908, p. 485, 591; March 1909, p. 289; Oct. 1909, p. 409.
(18) Skottsberg, "Bot. Ergb. der Schw. Exped. nach Patagonien u.d. Feuerlande, 1907-09." I. "Ubersicht über die wichtigsten Pflanzenform. Sudamer. S. von 41°." Svensk. Vet. Akad. Handl. Bd. 46, No. 3, 1910.
(19) Stephani, Ibid. II. "Die Lebermoose." l.c. Bd. 46, No. 9, 1911.
(20) Skottsberg, Ibid. III. "A Botanical Survey of the Falkland Islands." l.c. Bd. 50, No. 3, 1913.
(21) Skottsberg, Ibid. IV. "Studien über die Vegetation der Juan Fernandez Inseln." l.c. Bd. 51, No. 9, 1914.
(22) Skottsberg, Ibid. V. "Die Vegetationsverhältnisse langs der Cordillera de los Andes S. von 41° S. Br." l.c. Bd. 56, No. 5, 1916.
(23) Skottsberg, "The Wilds of Patagonia." (London, Edward Arnold, 1911.)

Juan Fernandez. (21, 23.)*

The Juan Fernandez group consists of two large islands, Masatierra (often called Juan Fernandez) and Masafuera, and the small island of Santa Clara, which lies off the west point of the Masatierra. Masatierra is 366 knots west of Valparaiso and Masafuera 92 knots further west. Both are high, mountainous and volcanic islands.

In the systematic list given by Skottsberg, 117 species are recorded, five new ones being described. The indigenous species of flowering plants number 105. Of these 72 (68·5 per cent.) are endemic and 33 (31·5 per cent.) non-endemic. There are 74 genera, of which 11 (15 per cent.) are endemic, and 38 families are represented, of which one (the *Lactoridaceae*) is endemic. The number of Pteridophytes is 43 (30 per cent. of the higher flora); 12 species (28 per cent.) are endemic, and there is one endemic genus. Of the 72 endemic Phanerogams 35 have their nearest relatives in South America, especially in Chile, 14 are clearly related to Polynesian, Australian or New Zealand species, two may have been derived from either Chilean or western species, while the remainder are of uncertain affinity or isolated.

Juan Fernandez belongs to the oceanic type of islands since it lacks land mammals, reptiles and amphibia; Gymnosperms, Orchids, *Liliaceae*, and *Amaryllidaceae* are also absent, and the

* The figures in brackets refer to the bibliographical list.

Leguminosae are represented by only one species (*Sophora tetraptera*). Quensel, who was with Skottsberg, found the islands were composed, as far as he could observe, solely of volcanic material, of uncertain age, but probably belonging to early Tertiary times. Skottsberg considers that colonization from existing neighbouring lands, Chile, Polynesia, New Zealand, etc., will not alone account for the existing flora, since the relatively short time which has passed since the present islands appeared would not be sufficient for the development of such isolated types as *Lactoris* and *Robinsonia*. He believes that the old element did not originate in the Juan Fernandez group, but is older than these islands and once spread over a large area in Polynesia, Chile, etc., subsequent changes in the Quaternary Period, however, altered the floras of these countries and isolated that of Juan Fernandez. The existence of more land in the Pacific in Tertiary times may have given developmental centres for a fauna and flora, whose scattered remains now especially inhabit the oceanic islands. Many things suggest that in spite of their recent volcanic nature the islands are the remains of a greater island or group of islands, but nothing definitely suggests that they formed in earlier times part of a transoceanic land-bridge or of a great Pacific continent.

The forest consists of evergreens, except *Berberis corymbosa*, which was leafless in July and August. It is a typical rain-forest, but is not sub-tropical, since it lacks obligatory epiphytes and lianes. The presence of two climbing ferns (*Arthropteris altescandens* and *Blechnum Schotii*) is interesting, and in general appearance the Valdivian forest is strongly recalled by the presence of such types as *Myrtaceae*, *Drimys*, *Sophora*, *Escallonia*, *Pernettya*, *Rhaphithamnus*, and *Chusquea*. On the other hand the lack of species of *Nothofagus*, so common in Chile, is striking, as is also the presence of such types as *Fagara*, *Psychotria*, *Boehmeria* and *Santalum*, which are absent from the Chilean rain-forest. These types are tropical or subtropical, but they do not change the mainly temperate character of the rain-forest. The absence of *Coniferae* is common to Juan Fernandez and many other oceanic islands. The Composite trees (*Rhetinodendron*, *Robinsonia*, *Dendroseris*, etc.) and other "feather bushes" give a characteristic facies to the vegetation.

A graphic account is given of a visit to the last remaining tree of the native sandle-wood (*Santalum*). The tree had only one living branch, and the reader is made to share with the author the intense emotions of a botanist witnessing the death of a species.

America south of 41° S. (4, 6, 11, 18, 22, 23.)

The results of the Swedish expeditions in the southern part of South America are extensive and important from the several aspects of systematic, geographical and ecological botany. In the last published work here dealt with, Skottsberg has brought together much of the information obtained during the four or five years he spent in the Southern Hemisphere, and has further modified some of the views he published in previous papers.

In the systematic list (22) 788 species are dealt with, many of them accompanied by valuable taxonomic notes. Thirty species new to the science are described, and two new genera, namely, *Pycrophyllopsis*, an isolated genus of the *Caryophyllaceae*, which is compared with *Colobanthus*, but is not closely related, and *Xerodraba*, a genus placed near *Draba* in the *Cruciferae*.

The southern part of Temperate South America may be phytographically divided up into four botanical areas: The Valdivian, the Cordilleran between 36° 30′ and 54° 40′, the Patagonian-Fuegian steppe, and the Magellanic.

Accepting the main divisions suggested by Engler (Engler and Gilg, Syllabus der Pflanzenfam. pp. 356-357), the following subdivisions are in accord with Skottsberg's results:—

III. Central and South American Floral Realm.
  C. Andine Region.
    1. Valdivian Forest Province, 36° 30′-48°.
      (*a*) Zone of Coast Cordilleras and the longitudinal valleys between 36° 30′ and 41°.
      (*b*) Zone of the islands and the western slopes of the Cordilleras between 41° and 48°.
    2. Andine-Patagonian Province.
      (*a*) Cordillera Zone between 36° 30′ and 54° 40′.
        (i.) Northern district up to 41°.
        (ii.) Southern district of the Patagonian-Fuegian mountains.
      (*b*) Patagonian-Fuegian steppe-zone between 41° and 54°, stretching eastwards up to the Atlantic Ocean.

IV. Austral-Antarctic Floral Realm.
  A. South American Subantarctic Region.
    (*a*) Magellanic Forest Zone of the West Patagonian-Fuegian coasts and islands between 48° and 56°.
    (*b*) Woodless island zone of the Falkland Islands.

The climate of the Valdivian Region is characterised by high winter temperature, great precipitation, especially in the winter, and predominating westerly and north-westerly winds. In brief, it may be said that this district has a warm-temperate rain-climate, with comparatively little difference between summer and winter. The district of the West Patagonian canals and islands (the Magellanic Region) may be said to have a cold-temperate, very stormy climate, with very little difference between summer and winter, and with much rain in all parts of the year. The eastern slopes of the Andes are poor in rainfall, and this is also true of Patagonia. Unfortunately the relatively few published records nearly all concern coast-stations, and since these have a less extreme climate than the inland districts they are not sufficient to give a general idea of the climate, which is largely of the continental type. On the Patagonian-Fuegian tableland there is slight precipitation and dry winds, and clear skies are the rule.

In one of his earlier works Skottsberg designates the Valdivian Forest as "the forest which is rich in species." Prominent among the tall trees are *Nothofagus Dombeyi*, *N. nitida*, *Laurelia serrata*, *Drimys Winteri* (the only member of the *Magnoliaceae* found in Chile), *Aextoxicon punctatum*, *Myrceugenia planipes* and the conifers *Fitzroya patagonica*, *Libocedrus tetragona*, *Saxegothea conspicua* and *Podocarpus nubigena*. There are many smaller trees and shrubs, amongst which may be mentioned *Guevina Avellana*, *Lomatia ferruginea*, *Embothrium coccineum*, *Weinmannia trichosperma*, *Sophora tetraptera*, *Aristotelia Macqui*, *Pernettya vernalis*, *P. mucronata*, *Gaultheria myrtilloides* and *Berberis Darwinii*. Species of *Chusquea* (bamboos) play a great rôle. Lianes are conspicuous and include *Griselinia racemosa*, *G. ruscifolia*, *Asteranthera ovata*, *Mitraria coccinea*, *Eccremocarpus scaber*, *Mutisia* spp., *Hydrangea integerrima*, *Boquila trifoliolata*, *Ercilla spicata*, *Elytropus chilensis*, and *Cynanchum lancifolium*. Parasites, except Fungi, are not common, but epiphytes occur in astonishing numbers of forms, the most common being Cryptogams, but species of *Luzuriaga*, *Rhodostachys*, *Peperomia*, *Mitraria*, *Asteranthera*, and *Griselinia* are found. The ferns include many *Hymenophyllaceae*, *Blechnum* (*Lomaria*) *magellanicum*, a tree-fern with Cycad-like form, and *Lophosoria glauca*.

The Magellanic (subantarctic) region has rain-forest over a very limited area, reaching only up to a few hundred metres. Even below the tree limit all the land is not forest-clad, for with the dark-green wooded areas there alternate nearly treeless moors where *Marsippospermum grandiflorum* is dominant. The wind is here the most important cause of the distribution of plant associations. In West Patagonia and Fuegia there is a maritime forest limit outside which the oceanic heath is developed as a cushion-heath. High trees do not occur in the Magellanic rain-forest. *Nothofagus betuloides* is not above 10-12 m. high, *Drimys* has an average height of 10 m., *Maytenus* is smaller, *Embothrium* at most 5-6 m., *Tepualia* seldom above 3-4 m. and *Pseudopanax laetevirens* 3-4 m. The only conifer which reaches Fuegia is *Libocedrus tetragona*. The absence of *Chusquea* spp. and true lianes is noteworthy, and there are no phanerogamic epiphytes. Dwarf shrubs are important in the moors and heaths and include *Empetrum rubrum*, *Gaultheria serpyllifolia*, and *Myrteola nummularia*. Cushion plants occur generally in the rocky coast district and are definitely related to the severe westerly gales which prevent the growth of trees. The cushion-plants include *Astelia pumilia*, *Bolax Bovei*, *Caltha dioneaefolia*, *Donatia fascicularis*, *Gaimardia australis* and *Abrotanella submarginata*. Near the glaciers the vegetation has a subalpine character and is a moss and lichen heath with *Empetrum rubrum*. *Marsippospermum* often occurs gregariously. Where the ground is flooded, meadows are found with *Hierochloa* and *Gunnera magellanica*. Alpine species of *Abrotanella*, *Cerastium*, *Epilobium*, *Geum*, *Lagenophora*, *Oxalis* and *Saxifraga* were observed.

Over the lower passes and through the Trans-Andine valleys the oceanic climate of the west coast passes inwards, and is

accompanied by the rain forest, but this generally loses some of the elements most characteristic of the coastal districts, and then forms a transition between the evergreen rain- and deciduous summer-forest. In North and Central Patagonia (41° to 44° S.) a forest of *Libocedrus chilensis* is interposed between the rain- and summer-forest. In other parts of the transition area *Nothofagus betuloides* occurs as a tree, reaching considerable dimensions.

The Andine forest girdle below the *Libocedrus* forest, that is from 44° to 55°, is especially characterised by *Nothofagus Pumilio*. Evergreen shrubs forming much of the undergrowth include *Berberis ilicifolia*, *B. Pearcei*, *Embothrium coccineum*, *Chilotrichum diffusum*, *Escallonia rubra*, *E. virgata*, *Maytenus disticha*, and *Pernettya mucronata*. Lianes are rare. Phanerogamic epiphytes are wanting, but parasitic species of *Myzodendron* are nearly always present. The herbaceous flora is richer than that of the rain-forest. *Nothofagus antarctica* occurs in all kinds of localities.

The whole of the Pampas area to the east of the Andes is covered with sand and gravel of Tertiary strata, and is a district poor in rainfall. There is a distinct periodicity of the vegetation, due to the marked winter-rest period. The dominating plant formation is the steppe. Nearly all the steppe plants are strongly xerophytic, and all kinds of devices for the reduction of transpiration are to be found. There are no trees, but shrubs are represented by *Embothrium lanceolatum*, *Berberis* spp., *Escallonia* spp., *Adesmia* spp., *Anarthrophyllum rigidum*, *Schinus dependens*, *Discaria* spp., *Verbena* spp., and *Lycium pulverulentum*. The floral richness of the steppes is striking. Flowers noteworthy for individual richness of colour are rare, but innumerable small flowers take their place. Amongst the most beautiful may be mentioned species of *Chloraea*, *Senecio*, *Mutisioideae*, *Embothrium*, *Verbena*, *Tristagma* and *Opuntia*. Cushion plants are abundant, and Skottsberg records 92 species belonging to 40 genera, placed in 24 families.

The following associations are to be met with: The *Mulinum spinosum* steppe, the grass steppe (*Festuca-Mulinum* association), the shrub steppe (especially found on the eastern shores of the great Andine lakes), and the vegetation of the desert-like ground.

Great tablelands (Mesetas) are raised above the pampas, and here Alpine heaths and meadows are found, including dwarf shrubs, rosette-plants, cushion plants and grass clumps. Many of the Alpine plants are noteworthy for their beautiful flowers with clear colours. Thus species of *Nassauvia* have white and lilac flowers, *Calandrinia rupestris* has orange, *Calceolaria uniflora* carmine, yellow and white, *Leuceria Hoffmannii* carmine, *L. leontopodioides* rose, *Perezia pilifera* blue, *Viola auricolor* golden-yellow, and the cushions of *Saccardophytum* and *Benthamiella* are covered with small yellow or white flowers.

It has been seen that the flora of the rainy coastal area of West Patagonia and Fuegia can be divided into two distinct districts—the Valdivian and the Magellanic. To the first belongs the greater part of the old Chilean floral element, which has its affinities in

Tropical America, and took on its special character during the elevation of the Andes, so that the existing differences between Chile on the one hand and Brazil-Argentine on the other are fundamental. The old Antarctic element is also important in this forest-flora, giving several of the species of trees, as *Eucryphia cordifolia*, *Nothofagus Dombeyi*, *Fitzroya patagonica*, and *Laurelia* spp. The Magellanic flora is composed of the same general elements as the Valdivian, but the Chilean species are less prominent, while the old Antarctic forms are more so. There are in South America remnants of an old Antarctic flora, which is also strongly represented in New Zealand, and also species of a New Zealand flora which is more weakly represented.

Nothing is known of the composition of the vegetation immediately before the Ice Age. It apears from the fossil record of South Patagonia and Fuegia that the climate of the Miocene Period was warmer and damper than that of the present. It is also probable that many types had wider distribution before the climate became too cold than they now have. Thus immediately before the Glacial Period forests of Andine character with *Libocedrus* and *Podocarpus* apparently occurred in the Falklands. The wind conditions were similar to those now existing, that is, the western slopes of the Andes acted as a weather-shield, and were probably covered with evergreen 'beeches.' At the time of maximum glaciation plants emigrated northwards or found refuge in the South Chilean coast cordilleras and also in Chiloe, where many subantarctic types may still be found. With the diminution of the ice the northern species migrated back to their old stations. The first vegetation to establish itself would consist of moor and heath plants with trees of the type of *Nothofagus antarctica*—such vegetation indeed as is found to-day near the great glaciers. Some species may have survived in specially favoured localities, but most of the present flora is more likely to have come (largely returned) from the North.

The Falklands. (12, 20, 23.)

The taxonomic constitution of the Falkland flora is fairly well known, and, except in a few details, Skottsberg's work has added little to the researches of older botanists in this direction. It is in his ecological surveys of the group, and his well-considered accounts of the geographical relationships and origin of the flora that he has chiefly increased our knowledge.

The monotony of the landscape always strikes a visitor to the Falklands. The gently undulating country is scarcely relieved on the hills by an occasional mass of grey, naked quartzite, or in the lowlands by extensive swamps, whose vivid green colour causes them to stand out sharply against the darker heath. The Falklands were never glaciated in the strict sense of the term, but the severer climate of the Glacial Epoch caused the accumulation of great snow-masses in the winter, which melting quickly in spring, flooded the land. The poor vegetation was unable to bind the ground, and great masses of semi-fluid soil originated from the soft weathered sandstone.

These half-fluid masses glided down into the valleys, the fine material was mostly washed out, but the larger blocks of resistant quartzite still remain in heaps and in the well-known "stone-runs" or "stone rivers."

The climate is extraordinarily suitable for peat-formation, and in the extensive swampy areas the peat layers grow slowly and surely, furnishing the inhabitants with their chief fuel. The absence of forests is partly due to the strong wind storms, but since similar storms occur on the Fuegian coasts, which are clad with luxuriant forests, other factors must combine with the winds. The peculiarities of the terrain and soil may be unfavourable for tree growth. The absence of a permanent protective covering of snow during the winter would also be inimical to many plants.

The vegetation may be described as a steppe. The grass-steppe is especially developed, but the grasses are often replaced by *Empetrum rubrum*, and sometimes by *Bolax glebaria*, thus merging into heaths. The characteristic plants of the heath formation are evergreen, and so periodicity is little evident to the eye. In his latter paper Skottsberg subdivides the vegetation into the following associations:

Cortaderia-association is one of the most important types of vegetation in the islands, being commonly developed on dried ground, especially where the subsoil is composed of fine-grained material.

Empetrum-association is also found on comparatively dry ground, being best developed on the mountain ridges and on stony plateaux. It consists of dwarf shrubs, herbs and grasses.

Chiliotrichum-association frequently forms a grey fringe along the streams.

Astelia-association is the Falkland representative of the peat-mosses of high-moor type, but the *Sphagnaceae* are of little or no importance. This association is partly responsible for the immense layers of peat which may reach several yards in thickness.

Rostkovia-association is characteristic of the wettest ground, being confined to the depressions, and corresponds to what is generally termed low-moor.

Cortaderia-Astelia-Rostkovia-association is common on soil intermediate in its moisture content and drainage between the *Cortaderia* association and low-moor.

Blechnum magellanicum-association inhabits ground round the quartzite ridges.

The vegetation of the stone-runs is especially characterised by *Nassauvia serpens*.

The alpine heath with *Empetrum* and *Bolax* covers the hill tops, and most nearly resembles the tundra of South Georgia, Kerguelen, etc. *Azorella Selago* and *Valeriana sedifolia* are confined to the highest summits.

The fresh-water vegetation is not well developed.

The vegetation of the sea-coast has largely altered since the advent of man and the introduction of domestic animals on the islands. The tussock-grass, *Poa flabellata*, once formed the most important feature of coastal plant-life. At present it is only to

be found on un-stocked islands, or in places inaccessible to sheep.

Veronica elliptica, the largest land plant of the Falklands, commonly accompanies and may replace the tussock-grass.

An analysis of the Falkland flora gives the following results:

Group I.—South Patagonian and Fuegian Element. This is by far the largest group, containing 133 species, or 82·1 per cent. of the flora. Although many of the species are confined to sub-antarctic South America, others have a wider distribution.

Group II.—Warm-Temperate element. This is composed of 14 species (8·6 per cent. of the flora), also found in Chile and the warmer parts of South America, and one in the North Temperate regions.

Group III.—Endemic Element. Composed of 15 species (9·3 per cent of the flora).

Hooker knew that most of the Falkland plants point to a Magellanic origin for the flora. Amongst the 82 per cent. of more or less common Magellanic plants there are a number of forest species, while the steppe element is not especially pronounced. The periodicity is much less marked in the Falklands, and a number of species from the rainy, evergreen forests therefore occur. The probable history of the flora may be summarised as follows:—

1. During the Tertiary Epoch the Falklands were raised above their present level, and the elevation may have been sufficient to establish a land connection with South America, even if of short duration.

2. Before the Ice Age coniferous forests of Chilean type existed in the islands, as is shown by the remains of fossil trees of a species of *Podocarpus* and *Libocedrus*, probably *P. salignus* and *L. chilensis*, on West Point island. Large areas, however, were probably even then inhabited by oceanic heath or meadow.

3. Judging from the present distribution of the above conifers the climate was warmer, but not necessarily drier, than now.

4. With the deterioration of the climate which culminated in the Ice Age, the forests disappeared and the tundra-like formation became predominant.

5. The Falklands were never glaciated, but the Ice Age was represented by the period of semi-fluid moving soil. During this time a large number of species may have survived.

6. In post-glacial times many species have probably immigrated from the west.

7. The warm-temperate element in the flora did not survive the period of semi-fluid soil, but immigrated in post-glacial times. This element may have come directly from its present habitat or, more probably, by way of Fuegia, which it may be assumed has undergone post-glacial changes, permitting a number of warm temperate species to extend their boundaries to the south.

South Georgia. (1, 5, 10, 14.)

South Georgia is an isolated, mountainous island lying in the southern part of the Atlantic Ocean and within the limits of the drift of Antarctic icebergs. The island gives a strong impression

of being part of a mountain chain, since it rises abruptly from the ocean, and has a very broken crest of considerable height, with numerous steep peaks, of which Mt. Paget reaches 2000 m. Two distinct periods of glaciations may be traced, and when the ice withdrew from the lowlands for the last time it left considerable deposits of morainic material in the valleys close to the coast. It is on those which have not been washed away that plants especially establish themselves. The present inland ice is of the Alpine rather than of the Antarctic type.

The climate is very similar to that of Fuegia and the Falklands, but the temperatures are lower, the summer shorter and the seasons less well-marked.

If the term "formation" be used in a wide sense all the vegetation of South Georgia may be described as tundra-formation, and the following associations can be recognized: 1. *Poa flabellata* association. 2. The vegetation of the rocky shore. 3. The inland tundra. 4. The swamps. 5. The fresh-water vegetation.

Skottsberg records four species of Pteridophytes and 16 Phanerogams. *Poa flabellata*, the tussock grass, is the most conspicuous member of the flora.

In the first period of glaciation the land was completely covered with ice and no vascular plants could have existed. The land may have been colonised in the interglacial period, and in the second glacial epoch some plants may have survived, or they all may have been exterminated. South Georgia has no endemic Phanerogams, such as are found in Kerguelen, which was never wholly glaciated. There is, therefore, no objection to accepting the view that the vascular flora of South Georgia is post-glacial. Further, there is no evidence of a land connection in post-glacial times with any continental area.

The flora is obviously related to that of Fuegia. The Cryptogams probably reached the island by wind-dispersal of their spores, while the seeds of flowering plants were possibly brought by birds who travelled with the prevailing west winds. It is only necessary to assume the arrival of one species every thousand years since the Ice Age to account for the species now found.

Amongst the mosses there are numerous endemic types which must be regarded as belonging to the preglacial flora. On the other hand, amongst the cryptogams generally there are many Magellanic species, some with circumpolar distribution, some found only in South Georgia and Kerguelen, and some only in South Georgia and the Antarctic continent. This supports the theory that there is here a branch of the old Antarctic flora, of which so many traces are found outside of the Antarctic proper, recalling a time when there was closer connexion than now between the different groups of islands—the South Shetlands, the South Orkneys, the South Sandwich Islands and South Georgia.

Graham Land. (15.)

The climatic conditions of the Antarctic regions are well known to be the most severe in the world. The strong wind storms clear away the snow in places, and if it were not for this no vegetation

other than lichens could exist, for the summer sun rarely raises the temperature above 0° C., and could not melt the snow. The greater part of the time the ground is frozen hard. Since the period during which life-activities may occur is so limited, it is no wonder that most of the mosses remain sterile, and only two flowering plants occur, and these not in such abundance as to give a facies to the flora. The rocks and stony ground may be colonised by crustaceous lichens. Closed patches of moss-tundra are seldom seen, but emerald-green mats of *Prasiola crispa* are found near the sea. Penguins occupy many areas which might have been occupied by plants. The ground is there covered with a half-fluid mass of guano, and no vegetation can exist.

Sixty-two species of mosses are known from the Antarctic continent, and the flora shows the greatest affinity with South Georgia and Magellanic countries. Most of the species are found in the Graham Land area. The flora of Victoria Land is much poorer, but three endemic species, including *Saconeurum glaciale*, representing the only endemic genus, occur both in Graham Land and Victoria Land. The only moss, *Bryum filicaule*, from Kaiser Wilhelm's Land is endemic there.

Geological, zoological and botanical facts are all in favour of a single origin for the scattered floras and faunas of the subantarctic and antarctic zone. The existing flora is the remnant of the old antarctic plant-world, but an extension of glaciation occurred in the Antarctic regions, and it is generally agreed that there were no ice-free spots, or even if there were, the temperature would prevent plants from growing. Hence the conclusion is reached that the existing flora has largely returned in post-glacial times to the regions it now occupies.

Cryptogams.

Taxonomically the richest botanical results of the Swedish expeditions are connected with the Bryophyta and Thallophyta. Cardot (10, 16) for the first expedition catalogues 444 species of mosses from the Magellanic region, of which 243 (54·7 per cent.) are endemic, and 48 are new to science. The same author (l.c.) enumerates 80 species collected by Dr. Skottsberg in South Georgia, of which 26 are new. 42 species of mosses are endemic in South Georgia, representing nearly 45 per cent. of the total recorded from that island. From the Antarctic continent 51 species were collected, five being described as new. Cardot was working at Lille on the mosses collected during the second expedition, when war broke out, and nothing had been heard of the collection up to the date of publication of Skottsberg's latest work. Stephani (3, 19) records 78 species of *Hepaticae* from the first expedition, describing five as new.

Darbishire (13) gives the following list for the lichens:—

	Total lichen species known.	Brought back by the Swedish Antarctic Expedition.		
		Total spp.	New locs.	New spp.
From Subantartic America ...	373	101	37	20
„ South Georgia	55	37	28	4
„ Antarctic regions ...	106	46	18	9
By Swedish Antarctic Expedition	—	145	—	33

There is very close affinity between the Antarctic lichen-flora on the one hand and the American and New Zealand on the other hand. South Georgia may be regarded as a half-way house on the road from Subantarctic America to the true Antarctic continent. Practically half the Antarctic species are common also to the Arctic.

For the Algae Skottsberg (8) has given a systematic list, with many valuable notes, of the *Phaeophyceae* of the Antarctic ocean. 53 species are recorded, of which 16 are new, as are eight genera and one family. There is an excellent account of the morphology, anatomy, taxonomy and geographical distribution of *Macrocystis pyrifera*. Foslie (7) has dealt with the Antarctic and Subantarctic *Corallinaceae*, enumerating 13 species, three being new. *Lithothamnion* and *Lithophyllum* are the most abundant genera. The calcareous algae are widely dispersed in the true Antarctic regions, and in some localities occur in considerable numbers of individuals.

Skottsberg has undoubtedly added valuable confirmation to the position taken up by Hooker in the introductory essay to the "Flora Antarctica." The southern part of the American continent is the headquarters of a botanical region whose flora is still found in isolated groups of islands extending 5000 miles to the east, some being nearer to the African and Australian continents than to the American. The existence must be accepted of an old Antarctic or Subantarctic Flora, at one time more continuous, or at least with its now separate parts having had a common origin. In reading Skottsberg's works one is impressed by the effect which the last Ice Age or series of Ice Ages had on the vegetation. The north and south direction of the Andes allowed the southern flora to retreat northwards in South America, and to return again when better conditions prevailed. A comparison between the flora of South Georgia which was, at least once, completely glaciated and that of Kerguelen, which was never completely glaciated, is most instructive in this connection.

The division of Fuegia and Patagonia into clear botanical provinces and zones is a noteworthy addition to geographical botany. Finally, the careful records of the vegetation of Juan Fernandez, the Falklands, and South Georgia, as it is at the present time is more especially important because colonisation is rapidly altering the floral facies of the islands, both by the destruction of native plants and by the introduction of exotic species.

XIX.—THE BOTANIC GARDEN OF PAMPLEMOUSSES.

(With Plates.)

An interesting history of the Botanic Garden of Pamplemousses, Mauritius, written by Mr. W. Edward Hart, Librarian and Curator of the Institute, was published in French in Mauritius in 1916. We are indebted to Mrs. F. R. Durham for the following abridged translation of the more important parts of Mr. Hart's paper.

The Garden has been successively known as Garden of Mon Plaisir, or Mon Plaisir, Jardin des Plantes, Royal Garden, and is now known as the Botanic Garden of Pamplemousses.

The Garden, which now covers an area of about 90 arpents (about 130 acres) started on modest lines, and its present condition of importance is due to the distinguished men who have been associated with its development.

Mahé de La Bourdonnais.—One month after his arrival at the Ile de France (June 5th, 1735), the Governor, François Mahé de La Bourdonnais, together with M. Pierre d'Albert, member of the Conseil Supérieur, bought from M. de Maupin the property of Mon Plaisir in the Pamplemousses District.

In the following year, having become sole proprietor, La Bourdonnais erected in the grounds a château and numerous other buildings, *i.e.*, a Chapel, where M. de Céré (later second Director of the Royal Garden) was baptized in 1837.

At the same time he planted a large part of his domain with vegetables to supply the needs of the "Camp," as the budding town—afterwards Port Louis—was called. A fairly large space was then sown with fatak grass for the raising of cattle, and another area near his residence was cleared for the cultivation of Mandioca, which he had just introduced from Brazil.

These cultivated grounds were soon transformed into a pleasure garden, enriched by fruit trees from Europe and India, to which he gave his special care, until he sold Mon Plaisir to the (French) East India Company on February 14th, 1737.

After La Bourdonnais' departure the whole of the grounds were planted with Chinese mulberry trees, with a view to establishing a silkworm industry. This attempt failed and was abandoned, but it was no easy matter to destroy the useless mulberry trees 30 years later, when it was decided, on Charpentier de Cossigny's resolution, to replace them by a plantation of "black wood," a species of Acacia introduced from the Malabar Coast, and furnishing timber as well as charcoal for the manufacture of gunpowder.

The gardens were entirely neglected until the arrival in 1753 of the naturalist Fusée Aublet, whom the India Company had commissioned to instal a central pharmacy and botanic garden on the Ile de France.

M. Aublet, though an eminent horticulturist and botanist, was unfortunately a man of suspicious and morose disposition, who made himself thoroughly unpopular from the first.

His character and prejudices appear in the preface to his book: "History of the Plants of French Guiana," followed by "Notes on the Plants of the Ile de France":—

"It was considered odd at the Ile de France that I should have been sent there for no fault. I was asked if I had come for a change of air. Immediately I became suspect, and was supposed to be condemning others, while only occupied in fulfilling my professional duties."

Soon after his arrival (August, 1753) Aublet took up his residence at Mon Plaisir, which he renamed Pampelmouze.

Climate, position, and the work already so well done by La Bourdonnais made him select this house for his experiments. He "prepared, sowed, and planted the ground to a great extent, but people, in whose way I stood, destroyed with as much ardour as I had expended in building up, so I was forced to leave this place next autumn (*i.e.*, six or seven months after my arrival) taking with me everything that had been spared and could be transplanted. Pamplemousse was henceforward devoted solely to the culture of vegetables for the Hospital, the Government, and the vessels going to India or returning to France."

"In another property 'Le Réduit,' I collected all I could procure of rare, useful or curious plants. I started a big farmyard, I had considerable grazing grounds, I increased the culture of lucerne and fatak. I planted useful trees, I rounded up all the cattle belonging to the Company (who were losing their produce and were often losing beasts) and had them coralled. I distributed a number of cows among the inhabitants on condition that half the produce should be returned to the Company, thus greatly helping to increase their numbers."

"In the midst of these occupations the gift of a so-called nutmeg tree and of nutmegs by M. le Poivre, caused me much annoyance, as I neither could nor would recognise this tree or its fruit for the true nutmeg of commerce. I reported to the Company to this effect, and thus made many personal enemies, who took their revenge in slandering me."

The M. le Poivre referred to was the traveller and naturalist Pierre Poivre, who landed on the island in 1775 on his second voyage, and introduced some seedling nutmeg trees which he had brought from the Moluccas, and presented to the Conseil Supérieur of the Ile de France.

Aublet persisted in his refusal to recognise these nutmeg trees or to plant them, until formally ordered to do so by the Conseil Supérieur. The nutmegs, however, died. Aublet was suspected of foul play, and it was even whispered that the young plants had been watered with boiling water!

Poivre.—After a series of travels in the Indies, China and Cochinchina, in the course of which he twice visited Mauritius, Poivre returned to France with a store of interesting observations on the Natural History, and with a very perfect knowledge of the customs, language and products of the countries he had visited.

The French Government ordered him to open up direct commercial intercourse with Cochinchina, and to import into the Ile de France and to Bourbon the spices hitherto only cultivated by the Dutch in the Moluccas. In 1767 he was appointed "Intendant Ordonnateur" and President of the Superior Councils of the two Islands.

On his arrival in July, 1767, at the same time as Governor Dumas, Poivre settled at Mon Plaisir, having observed that the climate of that region suited the culture of the spice and other plants imported by him from the Dutch Indies. He bestowed the greatest care on these new introductions, among which were the pepper and the cinnamon trees, some fruit trees, and others

yielding dyes and varnishes. He laid out the garden in a picturesque manner, and planted it with native, African, Indian, Malayan and Australian plants. He also made a network of irrigation canals for the proper supply of water. In 1769 Poivre sent out M. Provost, a former ' writer ' of the French East India Company's fleet, on a collecting expedition, which proved very successful. In June, 1770, the two ships under his command returned with 400 nutmeg plants, 10 clove plants and a case of clove seeds.

Another expedition under Provost in June, 1771, was even more productive. In June, 1772, the ships returned with numerous nutmeg and clove plants, which were distributed in the Ile de France, Bourbon, the Seychelles and Cayenne.

Poivre owed much to the advice of Philibert de Commerson, the distinguished naturalist, who had travelled round the world with Bougainville, and who settled in the Ile de France; also to Charpentier de Cossigny, whose property, Palma, had become a veritable nursery, and who generously presented to the Botanic Garden all the varieties which had succeeded at Palma.

Many explorers and men of science visited the Island, and some of them introduced new plants, such as the Indian Almond (*Terminalia Catappa*), the mango, mulberry, allspice, ravensera, peach trees, and the sago palm, while Sonnerat, who stayed at Mon Plaisir with Poivre for some time, introduced the bread-fruit, cocoa, mangosteen, and many other fruit-bearing or resin-yielding trees.

The Pamplemousse tree was a sort of orange (*Citrus decumana*), probably brought from Java by the Dutch. Its fruit, a large orange of slightly bitter-sweet flavour was called "bambolmas" in Tamil, perverted into "pamplemousse," and gave its name to that district of the Island rendered so famous by the author of "Paul et Virginie."

Bernardin de Saint Pierre paid more than one visit to Mon Plaisir, and though he was to give up his original idea of founding on the island a Republic on the lines of More's Utopia, he was inspired by a local anecdote, combined with the beautiful natural surroundings, to write the delightful arcadian pastoral, "Paul et Virginie." To this day there is shown in the Pamplemousses Garden the so-called tomb of Paul and Virginie, which is in reality only the stone of an ancient altar to the goddess Flora, erected by Governor Barthélemy David. (Plate ix.)

Although Poivre had spent a fortune on improvements and new installation at Mon Plaisir, he handed over the property to the Government on his departure in October, 1772, for the same amount as he had spent on its purchase, and refused to accept a larger sum.

Céré.—Before his departure Poivre recommended, as his successor, his pupil and friend Jean Nicolas de Céré, who had for some time efficiently collaborated with Poivre in the work of the Garden.

Céré was a Major of Infantry, Commandant of the Pamplemousses District, Director of the Royal Gardens, Chevalier of the Legion of Honour, Corresponding member of the Philippines

1.

2.

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4.

Economic Society, of the Agricultural Society, and of the Natural History Museum in Paris. Born on the Ile de France in 1737, he came of an Italian family of ancient nobility, settled in France since the 14th century, his father being a naval officer commanding the harbour.

Young Céré also started his career in the Navy, and after two campaigns, settled in the Ile de France, where he had meanwhile inherited considerable property from his father. Soon after his arrival he met Poivre, who was greatly taken with the serious and high-minded young man, who showed such a pronounced taste for botany—and so the foundation for a life-long friendship and co-operation was laid.

Céré's financial independence enabled them to overcome the opposition of the "Intendant" of those days. He did not hesitate to emulate his friend and master in sacrificing his private fortune to carry out important improvements in the Garden.

The growth and flowering of the first spice plants of the Gardens were followed in France with close attention, and announced as great events.

Albert Pitot, in his "Sketches," states that the first clove flowered in 1775, and the first fruit that had set was solemnly picked by Céré in the presence of the authorities, and sent home to France by Chevalier de Ternay, as a humble gift to His Majesty. Two years later the clove bore a large crop. The nutmegs were longer in maturing. The first flower appeared in March, 1778, the first fruit being once more solemnly picked in December, and despatched to the King.

Céré's merit was recognised in spite of all opposition, and in 1775 he was appointed Director of the Royal Garden.

Here he effected great improvements, and carried out many useful works at his own expense. Pepper trees, cinnamon, cloves and nutmegs soon increased largely, and seedlings were distributed among the inhabitants of the two islands. This experiment was so successful that a few years later a private citizen reaped 28,000 cloves, and M. Hubert, at Bourbon, had in 1782, a plantation of 8000 clove shrubs.

M. Céré extended his patriotic benefactions even further, sending cases of plants from his nurseries to the French Colonies of America.

The traveller Melon, who landed on the Island in 1786, after visiting Europe, Egypt and Asia, recorded his impressions of Mon Plaisir as one of the marvels of the world, the climate of the Island permitting the culture of the products of all parts of the globe. There were over 6000 kinds of trees and shrubs from different continents, some of which plants had not yet reached perfection.

Hospitality was extended by Céré to many well-known men, such as Suffren, d'Entrecasteaux, Booz, Commerson, Stadtmann, and others, who came to him with introductions. Among them was the botanist Du Petit-Thouars, whose brother commanded the vessel sent to find Lapérouse, and who, on his arrival at the Island in 1793, learnt that the vessel had been lost with all his private fortune. Céré proved his sympathy in keeping M. Du

Petit-Thouars as his guest for 18 months, and spared no delicate attention to make him feel at home.

Auguste Céré.—Céré having died in 1810, he was succeeded by his son Auguste, as Director of the Pamplemousses Garden.

Auguste Céré continued the excellent traditions he had inherited from his father, until on December 3rd, 1810, the Island was surrendered to Great Britain, and General Darling abolished the Communal Councils of which Céré was a member, as Commandant of Pamplemousses, thus depriving him of his post.

White and Burke.—His successor, White, had but a meagre knowledge of horticulture, agriculture or botany, and in order to hide his ignorance, an honorary Supervisorship was created, the chief of the Island Medical Service, Burke, being appointed to it. But owing to White's carelessness weeds soon gained ground and choked many of the rare exotic plants obtained with so much labour and expense.

Newman and Charles Telfair.—The Garden was falling into sad neglect, when, in 1826, Newman was appointed to succeed White; he was warmly recommended by Lord Bathurst. Charles Telfair replaced Burke, and stimulated Newman to activity; he rescued the Garden to a certain extent from its derelict condition, adding some new species, and replacing others which had been destroyed. Telfair, however, allowed himself to be distracted from his public work by devoting much time and care to his own property, "Bois Chéri," where, with the aid of the botanist Bojer, he was naturalising plants with a zeal equal to that of Poivre and Nicholas Céré.

His post was abolished in 1829, and Newman had the whole administration of the Garden. Matters moved very slowly, and appeals to the Natural History Society, etc., remained unanswered, when at last, moved by warnings from many quarters, Sir William Hooker, Director of the Royal Gardens, Kew, persuaded Earl Grey, then Colonial Secretary, to authorise the Government of the Island in 1848, to raise the funds necessary for the restoration of the Garden.

James Duncan.—This arduous task was confided to James Duncan, who was appointed Director of the Garden in May, 1849, and occupied the post for 15 years with great success.

He surrounded the Garden with an impenetrable hedge of Madagascar plum (*Flacourtia Ramontchi*), and introduced many rare and beautiful trees and shrubs. Some idea of his activities may be gained from his "Catalogue of Plants in the Royal Botanic Garden of Mauritius," published in 1863.

A violent cyclone raging for a week in February, 1861, destroyed numerous valuable plants. Duncan kept up the traditions of the Garden, and in the year 1862 alone, 25,925 plants were distributed by him to the inhabitants.

Dr. Charles Meller.—Duncan's successor in 1866, Dr. Charles Meller, was sent to Australia and New Caledonia to obtain new

varieties of sugar cane, as the canes on the Island had been ravaged by disease. Meller sent several kinds to Mauritius and saved its agriculture from imminent ruin. He died in New South Wales.

John Horne, who had been temporary Director after Duncan's departure, as well as Assistant Director under Dr. Meller, became temporary Director after the latter's death in 1866, was appointed Director in August, 1876. He was sent to Fiji in 1877 to procure new canes, which proved of great value.

William Scott.—From February, 1881, William Scott was Horne's assistant, and succeeded him as Director in August, 1893. General Gordon stayed with him for some weeks when he visited the Island. Scott was a very able Director, and his annual reports show the extent of the works and improvements carried out under his régime. His activities were sadly hampered by the hurricane of April 29th, 1892, which destroyed a great many valuable specimens, though by dint of great care and patience he succeeded in saving a certain number, so that the Gardens soon resumed their normal appearance.

Just as the Gardens were recovering, on December 5th, a cyclone, the centre of which was about four miles to the east of the Island, wrought great havoc among the buildings and gardens of the establishment. The orchid houses and pavilions were wrecked, and many palms and other trees uprooted and broken.

The big *Lodoicea Sechellarum* was stripped of its leaves and nearly died, the lakes were choked with fallen trees and branches. Once more great efforts were needed to repair the damage.

In the year 1897 also, there was an exceptional drought, which caused great damage. The lakes in the Gardens were almost entirely dry, and great efforts were needed to keep the plants alive.

Joseph Vankeirsbilck. Paul Koenig.—After Scott's departure Joseph Vankeirsbilck was appointed Director of the Gardens in July, 1898; he occupied this post until his death in September, 1903.

After his death in 1903, Paul Koenig took over the post of Director. His first annual report gives an interesting description of the varieties of palms growing in the Gardens.

The 1905 report gives a good idea of the progress made since the publication of Duncan's Catalogue:

Duncan had distributed 25,925 plants among the Islanders in 1862, while in 1905, 317,291 plants from the Gardens were sold, given away or exchanged at home and abroad. The swamp of Mon Plaisir was drained, and after an unsuccessful experiment of planting it with Lichis, it was turned in part into a rice field (where 16 varieties from Madagascar, Ceylon and British Guiana were very successfully grown), and partly planted with lime trees raised from garden seedlings.

In 1909 Java tobacco seeds were sold or given away to the

Islanders, and new kinds of sugar canes were received from Queensland and the West Indies.

While cocoa and some rubber trees from Madagascar had hitherto given very poor results, mandioca and coffee were growing very satisfactorily in 1912.

On the creation of an Agricultural Department the Pamplemousses Botanic Garden passed under the administration of the Director of that Department in July, 1913.

The new Director created a section for economic plants, which soon had to be enlarged to its present extent of 10 arpents.

In 1912 and 1913 it was found that the ornamental plants and trees had been sadly neglected, and much labour was needed to reduce their too luxuriant growth. Many fresh specimens of flowers and plants were grown, and the Gardens were replanted section by section.

A marble tablet was also put up in the Duchess of York Square to commemorate the planting of two Norfolk Island Pines (*Araucaria excelsa*) by Queen Mary in August, 1901.

The 1914 report shows the considerable development of the experimental cultivation and scientific study of the sugar cane, but cotton has given purely negative results, owing to the ravages of *Tortrix insulana* and other pests.

The Public Works Department have restored the buildings, and are keeping the roads and paths in excellent condition.

The exchange of plants and seeds with other countries has grown enormously. But it is chiefly in the study and cultivation of the sugar cane and the scientific application of manures increasing its productivity, that the Pamplemousses Garden is rendering such valuable services to the Empire. It may well be said that to-day it has attained the high-water mark of its usefulness in this respect.

Explanation of Plates IX. & X.

1. The "Tomb" of Paul and Virginie, with a plant of *Encephalartos Hildebrandtii* on either side.
2. Avenue of the "Tomb" of Paul and Virginie, Pamplemousses.
3. Lake in the Botanic Garden.
4. A corner of the Botanic Garden, with Sabal Palms and *Areca Catechu* in the centre.

XX.—MISCELLANEOUS NOTES.

Botanical Magazine.—The following plants are figured in the number for April, May and June:—*Liparis macrantha*, Rolfe (t. 8797), from the Island of Formosa; *Malus rivularis*, Roemer (t. 8798), a native of Western North America; *Wittia panamensis*, Britton & Rose (t. 8799), from the mountains of Panama; *Lonicera similis*, Hemsl. var. *Delavayi*, Rehder (t. 8800), from South-Western China; *Primula bellidifolia*, King ex Hook. f. (t. 8801), a native of the Eastern Himalaya; *Rhododendron*

oleifolium, Franch. (t. 8802), from the mountains of Yunnan; *Calanthe tricarinata*, Lindl. (t. 8803), from Northern India, Yunnan and Japan; *Lonicera chaetocarpa*, Rehder (t. 8804), a native of Western China; *Desmodium cinerascens*, Franch. (t. 8805), also from Western China; *Ipomoea Pes. Tigridis*, Linn. var. longibracteata, Vatke (t. 8806), a native of Eastern Tropical Africa, and *Disporum pullum*, Salisb. var. *brunnea*, C. H. Wright (t. 8807), a native of Western Hupeh, China.

Forest Law in America.*—In this work the development of forest law in North America is discussed so far as it affects forest fires, the preservation of existing forest resources, the reafforestation of cut-over or burned-over land, the extension of forest areas, and the systematic management of forests for productive purposes, from its inception in the seventeenth century to the close of 1916. The book consists of 254 pages of letterpress, exclusive of introductory matter and an ample index, and is divided into seven chapters which are sub-divided in order that the various laws as they affect different States may be conveniently handled. Almost from the earliest days of the occupation of America by Europeans, individuals appear to have interested themselves in forestry matters and numerous laws were passed by different States in the seventeenth and eighteenth centuries concerning the indiscreet cutting of timber and fire protection. These laws, however, had no very far-reaching effect, and although a general forest policy was urged upon several occasions it was not until 1885 that the first comprehensive forest administration Act was passed. This Act was the result of the deliberations of a committee of experts appointed by the comptroller of New York in 1884 to investigate and report upon a system of forest preservation suitable for adoption by the State. It carried an appropriation of 15,000 dollars for the expenses of the first year, and provided for a permanent forest commission of three members, a state warden, state inspectors and other necessary agents; created a forest reserve to consist of all lands then owned or thereafter to be acquired by the state in eleven counties in the Adirondack region and three counties in the Catskill Mountains, and declared that the lands comprising the reserve should be for ever kept as wild forest lands in the full control of the State and not be sold, leased, or taken by public or private corporations. Full provision was made for the prevention and control of forest fires; railroad companies were required to clear rights of way of inflammable material in forest or other land particularly subject to fire, to equip locomotives with proper appliances for the prevention of fires, and to employ patrolmen in dangerous periods. From 1885 onward Acts and amendments appear to have been passed with bewildering frequency and Mr. Kinney has done good work by summarising

* The Development of Forest Law in America, by J. P. Kinney, A.B., LL.B., M.F., Chief Supervisor of Forests, United States Indian Service, New York: John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, 11, Henrietta Street, Covent Garden, W.C. 2. Price 11s. 6d. net.

them in a concise form in his present book. Some idea of the work entailed in the compilation of the book may be gathered from the number of footnotes given in reference to the different Acts. W. D.

The Essentials of American Timber Law.*—This is a companion volume to "The Development of Forest Law in America," by the same author, published in 1917. It deals with American Law in relation to property under its various classifications, the forms of private possession of land, trees and timber as property, the liability of tenants regarding timber, waste as applied to timber, remedies for waste, civil liability for trespass upon timber, and for the conversion of timber products, statutory civil liability for timber trespass, injuries to growing trees as a criminal offence, contracts regarding growing timber, contracts regarding the preparation and manufacture of timber products, contracts for the sale of timber products, the inspection and measurement of timber products, the transportation of timber products by flotation, standing timber as included in a mortgage, trees on a boundary line or in a highway, trees nursery equipment, and sawmills, as fixtures, and the policy of the national government in regard to the free use of timber taken from public lands. The main object of the work is to place before landowners, foresters, and lumbermen a concise summary of American Law as it affects their interests as interpreted by legal decisions. When possible it is compared with British Law upon similar subjects. The book represents a great amount of work, for the matter has had to be sought for in many places, as is instanced by the numerous footnotes referring to cases that have been decided in North American and British Courts of Justice. W. D.

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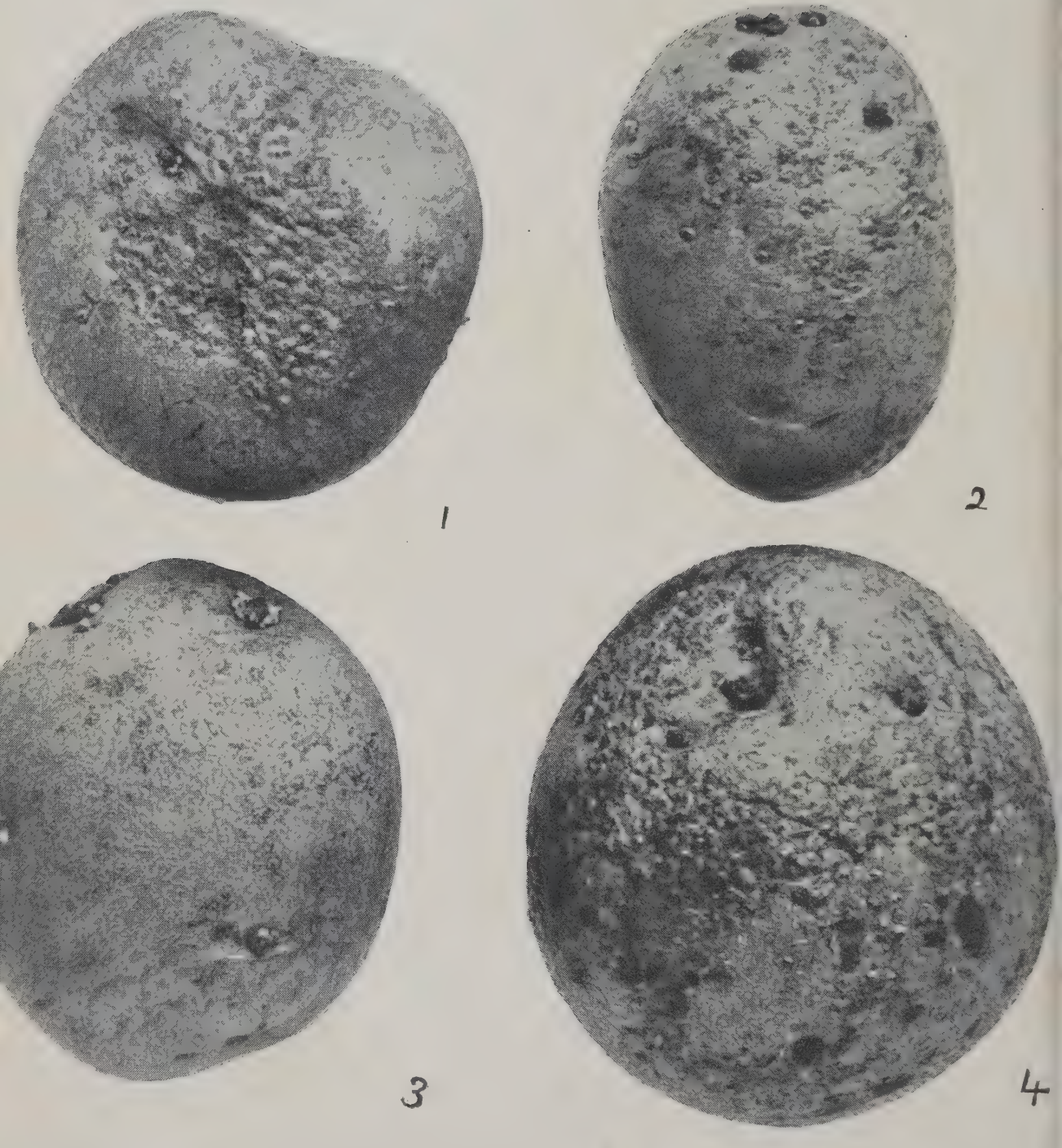
* The Essentials of American Timber Law. By J. P. Kinney, A.B., LL.B., M.F. New York, John Wiley & Son, Ltd.; London, Chapman and Hall, Ltd. (1917), price 13s. 6d. net.



ate XI.—Potato tubers affected with Skin Spot. 1, 3, 4. Arran Chief. 2. British Queen.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 8] [1919

XXI.—THE SKIN SPOT DISEASE OF POTATO TUBERS.

(*Oospora pustulans.*)

(With Plate.)

M. Nest Owen.

The disease known as Skin Spot is one of the minor diseases of potato tubers, and one which has never been thoroughly investigated. It is essentially a disease which develops in storage, a fact which probably accounts for its having been so long overlooked and so little understood. In certain seasons, however, Skin Spot is very abundant, and it appears to be becoming more prevalent than formerly. The affected tubers are dotted over with small dark spots, which are at times so numerous as to weaken or even to kill the eyes, and by disfigurement, to lower the market value of the tubers.

In the following paper a description of the causal fungus, which proves to be a new species of the genus *Oospora,* is given, together with an account of its growth in pure culture, infection experiments, and notes as to the effects of the disease on the tubers Although there is room for further work to be carried out with regard to the Skin Spot disease and the causes contributing to its development, it is thought that the results obtained should be placed on record, especially since no detailed account of the disease exists, and the identity of the fungus causing the disease was quite unknown.

Historical.

Carruthers seems to have been the first botanist clearly to distinguish Skin Spot. In March, 1904, he received some potatoes from Lincolnshire, which he states were covered with numerous bluish black warts (Journ. Roy. Agric. Soc. of England, Vol. 65, 1904, pp. 261-262, fig. 2 A-E). When thinly peeled a dark brown patch was found below each wart, and when crowded together the patches became confluent. On dissecting these patches, the cells of the potato were found to be permeated

(587.) Wt. 158—829. 1,125. 9/19. J. T. & S., Ltd. G. 14. Sch. 12.

with a very fine mycelium. The fungus had consumed the cell-contents, and thickened cell walls formed a corky layer, which separated the diseased part from the healthy cells. He was unable to obtain any fructifications or other characters to determine the fungus present. He gives diagrammatic figures of the external and internal characters of the "wart." In his report for 1909, Carruthers again mentions the recurrence of this particular form of scab, but makes no further comment. Though the description is not very precise these records have usually been regarded as referring to Skin Spot, and a note by Güssow, published last year, proved this assumption to be correct (*see* below).

In 1915, Pethybridge, in his Annual Report on Investigation on Potato Diseases for 1914, gives (p. 35), a note on the occurrence of the disease in Ireland, and proposes the name "Skin Spot." He states it was characterised by the presence on the skin of the tubers of rounded depressed areas, about 2 mm. in diameter, dark brown in colour, with a somewhat lighter coloured, rather well-marked margin, the central portion of each of these shallow pits being usually somewhat raised. He obtained a strong growth of a fungus by exposing cut surfaces of spot to a moist atmosphere. The fungus was identified for him at Kew as *Spicaria solani*. It is possible this species was present, but if so it was probably secondary. No cultural or infection experiments were made. His remarks were illustrated by photographs showing very typical diseased tubers.

Milburn and Bessey in their work "Fungoid Diseases of Farm and Garden Crops," 1915, describe under the heading "Blotches or pimples" (pp. 90-91), a spot on potato tubers evidently identical with the present disease. They refer to Carruthers' paper, and give *Spicaria nivea* as the causal organism. They remark that the spots, though visible at lifting time, are more noticeable after storing, and point out that not only do they render the tubers unsightly and thus reduce the market value, but they may destroy the eyes. They further refer to a case of "Evergood" producing a very irregular crop through the eyes being killed. As far as can be seen from their illustrations, the fungus observed was identical with that described in the present paper. Dr. Milburn informs me that the development of the spot during winter was particularly noticeable on the warp soils of Lincolnshire.

Güssow, in a brief note, describes Skin Spot as occuring in Canada, on potatoes from Quebec (Phytopathology, 8 No. 9, pp. 493, Sept. 1918). He illustrates his remarks with an excellent photograph and states that it is identical with that which he saw in England when working with Carruthers (in 1904). Although he admits the presence of fungal hyphae in the diseased areas, he attributes the disease to bad ventilation during storage, and considers that it occurs most frequently in those cellars where the potatoes are covered with soil to guard against the effects of frost.

In the first Annual Report of the Plant Disease Survey, undertaken by the Food Production Department of the Board of

Agriculture (1917), Skin Spot is listed as a disease prevalent during the winter of 1916-17, especially in the variety "Arran Chief" (Bd. Agric. Miscel. Publ. No. 21, 1918, p. 13). Finally it has been briefly referred to by Mr. A. D. Cotton, in his paper on Potato Diseases issued in the March Supplement of the Board of Agriculture's Journal for March, 1919. It is there stated (p. 47) that the causal fungus is not *Spicaria solani*, but probably an undescribed species.

External Appearance of the Disease.

The external characters of "Skin Spot," although not very striking, are quite distinctive, and there is not much likelihood of confusing it with other "spots." When a large number of potatoes are examined it becomes apparent that the spot may assume a somewhat different form according to the variety of potato on which it occurs. In the case of the coarser-skinned varieties, such as "Arran Chief," a definite pimple is developed, and the skin, which is never ruptured, is stretched tightly over the swelling, giving it a rather shiny appearance, which is most marked when a number of spots have arisen so close to one another that they coalesce. These swellings when dry are very similar in colour to the normal skin, but on being wetted stand out as a darker brown. In the case of the thinner-skinned and smooth varieties, however, such as "King Edward," the diseased areas are rarely if ever raised, but consist of small sunken dark circular spots with a slightly raised centre, the area being brown or even black in colour. The latter agrees exactly with the description given by Pethybridge. These two forms have never been noted on one and the same tuber; intermediates, however, sometimes occur. In the case of both the pimple and the flat form, each affected area appears to be the result of individual and separate infection, and rarely extends for more than 1 mm. in diameter, or to a greater depth than 2 mm. It has been stated that the rose-end of the tuber is more liable to infection than the heel-end, but when a large number of specimens are examined this statement is not found to hold good. Very frequently, however, one side will be much more spotted than the other. Often the spots occur so close to one another that many of them merge, and thus extend over a considerable area, rendering the tuber very unsightly and injuring a considerable portion of the surface tissue.

A noteworthy point in connection with Skin Spot is the ease with which an entire spot or scab may be picked out. If removed with the point of a needle a white socket of sound potato tissue is usually left behind. The explanation of this is seen by means of a section, when it becomes apparent that the injured area is cuticularised and thus sharply isolated from the cellulose parenchyma of the flesh.

Microscopic Characters.

On sectioning one of these spots the hyphal threads of the invading fungus are plainly seen among the cells of the potato tissue which have become brown and dead. The filaments are

exceedingly fine, 2-4 μ in diameter, hyaline or pale brown. The cell-walls appear to be somewhat thickened and cuticularised and to be lined with a brown substance, due probably to the decomposition of the cell-contents. The fungus penetrates below the periderm and invades the parenchyma, often to a depth of 12-15 cells. The starch grains in the invaded cells entirely disappear. The progress of the fungus is apparently retarded by the cuticularisation of the cell walls, but attempts are also sometimes made on the part of the potato to form definite layers of cork below the affected part (see Fig. 1). In some cases successive

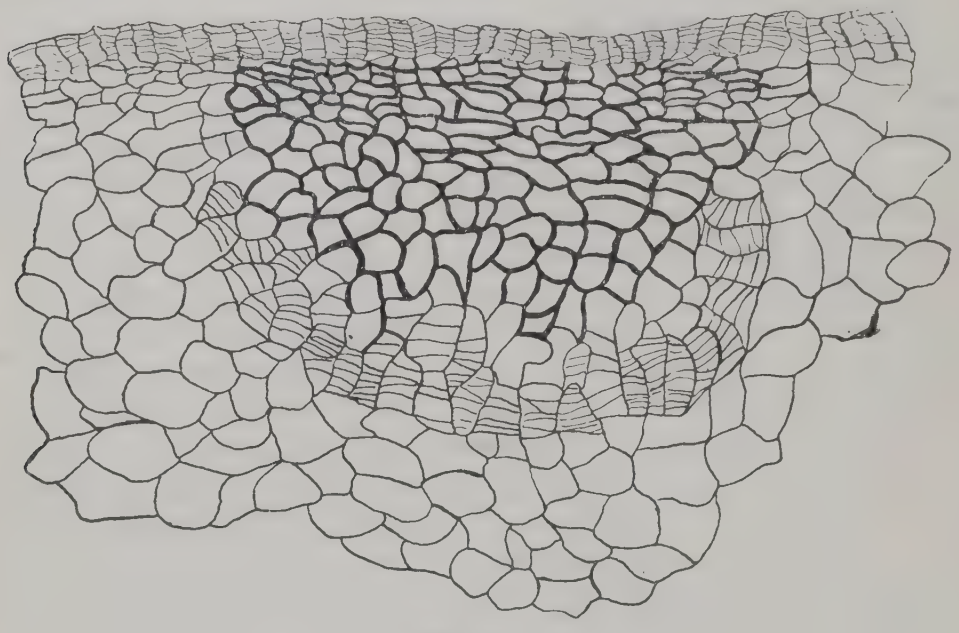


Fig. 1.

layers of cork are formed. Early in April, when the fungus appears to be most vigorous, the hyphae in the diseased cells are very numerous and for the most part hyaline; but later in the season, if similar areas are examined, very few hyphae are found, and these are mostly brown, probably as the result of age. Judging from the smallness of the area which results from each infection, and from the fact that after a certain period of time the hyphae, instead of penetrating to fresh cells, gradually die, the fungus can be regarded as only a very weak parasite on the potato tuber.

Pure Cultures of the Fungus.

No difficulty has been experienced in isolating the fungus in pure culture. The tubers were washed in running water and then placed for ten minutes in ·002 per cent. mercuric chloride solution and afterwards washed in sterile water. In order to lessen still further any chance of contamination the tubers were sometimes dipped in spirit and allowed to dry. The top of a scab was then sliced off with a clean sharp knife and the brown tissue below lifted with a sterile needle and placed on suitable media. In this way a large number of inoculations have been made from different tubers on various media, and in every case a similar

fungus obtained. Care was taken only to use those spots which close examination showed had the skin unbroken.

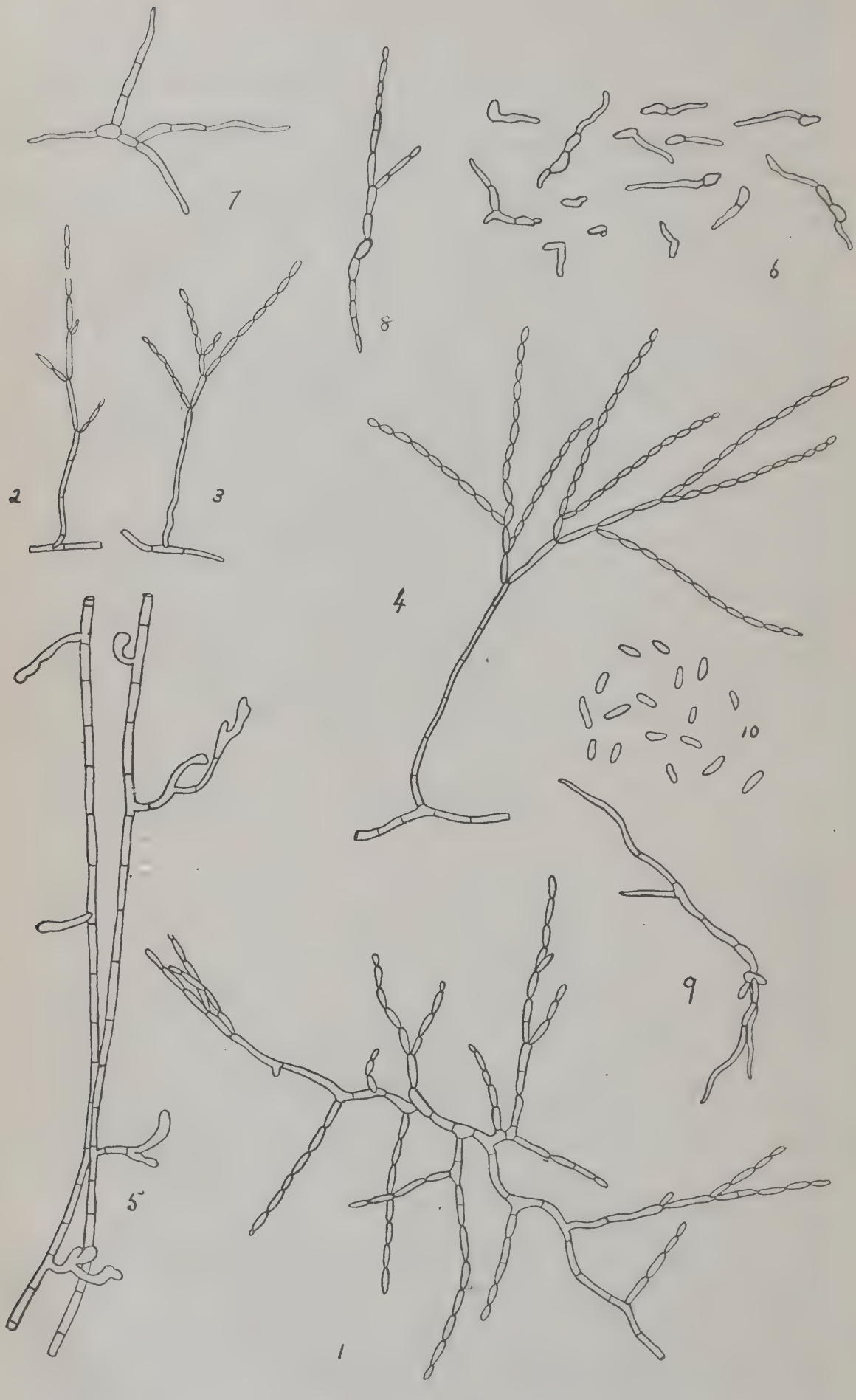
The first attempts to grow the fungus were made in March, 1918, on fresh potato agar, when it fructified but the growth was exceedingly slow. Attempts made more recently to grow it on potato agar have, however, been much more successful. It is probable that the temperature factor plays an important part in the growth of the fungus and accounted in a large measure for the slow growth first obtained in cultures.

Inoculations were made with a large variety of other media, including oatmeal agar and gelatine, bean agar, soil-extract agar, bread, meat-extract agar and gelatine, also liquid extracts of potato and meat, when it was found that the fungus was more or less indifferent to the kind of medium employed. Of the agar media, oatmeal agar gave the best growth, and on bread slants, although much mycelium has developed, very few spores were formed. The growth was more rapid on liquid cultures, but the most recent inoculations showed that the media on which the fungus grows best are cooked vegetable-tissues, such as potato, carrot, parsnip, etc. On these the growth is not only of a more luxuriant type, but exceedingly rapid—an area covered on these media in a week being equivalent to a month's growth on agar media. In the case of the series of cooked vegetable slants parallel cultures of uncooked slants were made in order to ascertain whether the fungus would grow parasitically, but as the following table shows, such was not the case.

——	Sterilised media (saprophytic growth).	Uncooked media (Parasitic growth).
Apple	Very slight growth	No growth.
Artichoke, Jerusalem	Good growth	„ „
Beet	Moderate growth	„ „
Carrot...	Good growth	„ „
Parsnip	Moderate growth	„ „
Potato	Good growth	Very poor growth.

The readiness with which the fungus grows under saprophytic conditions and the very slight parasitism which it displays on the potato tuber suggest very strongly that the fungus is normally a saprophyte, probably living on dead organic matter in those soils rich in humus, on land heavily manured with farmyard or other organic manures.

It has already been suggested that temperature is an important factor in the growth of the fungus, and although it has not been possible as yet to go into this matter in any detail, a few observations have been made. Parallel cultures were inoculated and placed immediately (1) in normal room temperature (12° C.), (2) in an incubator at approximately 24° C., and (3) at a temperature just below freezing point. At the end of a week there was no growth in any of the tubes except in that kept at room temperature. The tube kept at 24° C. and also that kept below



1. The fungus growing in hanging drop culture; after five days, showing young stage, before the development of erect conidiophores. × 250.

2-3. A day or two later, early stages in the development of erect conidiophores. × 250.

4. An erect branched conidiophore. × 250.

5. Appressoria-like organs. Magnification slightly more than 250.

6-7. Spores germinating in hanging drop.

8. Spore germinating by budding.

9. Spore germinating, showing four germ tubes.

10. A group of spores from cooked-vegetable culture, showing slight irregularity of size and shape.

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freezing point were then placed at room temperature. Within a few days that kept below freezing point developed in normal manner, but in the tube kept at 24° C. the spores did not germinate for some considerable time. Light does not seem to be an important factor. The fungus grows more rapidly in complete darkness than in diffuse light, but even in bright light it makes good growth.

Hanging-Drop Cultures.—Owing to the extreme readiness with which the spores become detached, it was found very difficult to observe the exact structure and development of the conidiophores, except by hanging drop cultures. For this purpose a thin film of potato agar was used. Germination takes place in one or other of the following ways a few hours after sowing. Fresh spores may be budded off or a mycelium may be produced, which grows out indefinitely or terminates in a chain of spores. Two or more lateral germ tubes are usually produced near one end, either base or apex, of the spore, which is narrow and elliptical in shape. The first few cells formed are often shorter and more swollen than those of the normal hyphae. The latter are slender and uniform in diameter, 2-4 μ, closely septate, at first hyaline but afterwards pale brown. Towards the edge of the colony peculiar abortive branches are to be noted which may, perhaps, function as appressoria (see Fig. 5, p. 294). Anastomosis takes place, but sparingly. The first formed conidiophores are usually decumbent but the majority are erect (as seen in tube cultures) though never attaining a height of more than 260 μ. The spores are produced at the ends of short hyphae by means of acropetal budding. These spores arise either terminally or laterally with the result that the branching of the conidiophores is quite irregular.

Systematic Position of the Fungus.

From what has been said it is clear that the fungus isolated is a Hyphomycete, belonging to the section *Mucedineae*, and that, judging from the description given by Rabenhorst (Krypt. Flora, Band 1, Abt. 8, p. 352) it is not closely related to *Spicaria solani* as had been suggested. In order to make certain of this point Mr. Cotton kindly wrote to Dr. H. M. Quanjer, of the Wageningen Phytopathological Institute for further details as to this fungus. I am much indebted to Dr. Quanjer for a copy of

the original description, and a copy of the figures by Harting. As the description is difficult to obtain in this country, it appears worth while to transcribe it here in full:—

"1. La surface de plusieurs tubercules appartenant à la variété dite 'Westenbergers' était couverte d'un certain nombre de verrucosités blanches, dont la base se trouvait dans le parenchyme sous l'épiderme. La fig. 1, Pl. III. donne la section d'une telle verrucosité à un grossissement peu fort. J'ai trouvé un champignon appartenant à la même espèce sur la section d'une pomme de terre venue de Munich: la ses filaments ne formaient pas des verrucosités, mais étaient réunis en flocens d'une certaine étendue. Au reste tous les signes caractéristiques étaient absolument les mêmes: la forme générale ne dépend que du lieu où le développement se manifeste.

Les filaments sporifères naissent perpendiculairement des filaments entrelacés qui constituent le mycelium (V. la fig. 2 et 3, Pl. III). Les deux espèces de filaments ont des dissepements. Ceux qui portent les sporules se divisent au sommet en 2-6, ordinairement en 4 ramules, qui ont une forme subulée et dont la direction n'a dévié pas de celle du filament. Les sporules, trés petites, ellipsiodes, naissent au sommet de ces ramules. Quelquefois les filaments se divisent en deux branches, dont chacune se subdivise en ramules sporifères. L'ensemble de tous ces filaments, qui constituent le bord de la verrucosité (fig.1), rappelle un champ couvert d'épis de blé.

Le diamètre des filaments fructifères est de 3, 6-5, 7 mm. La longueur des sporules est de 3, 1-6 mm. Leur largeur de 1, 7-4 mm.

Une description de ce champignon appartenant ainsi que tous les suivants a la famille des Hyphomycetes ne m'est pas connue. Il approche du genre Verticillium Nees, par la manière dont les sporules se forment, mais c'est un Verticillium sans branches latérales, et j'ai donc cru devoir en former un genre nouveau, auquel j'ai donné le nom de Spicaria.

Ses caracteres sont:

Flocci tubulosi septati biformes, steriles decumbentes, fertiles erecti vulgo simplices, apicibus in ramulos fertiles verticillatos divisis; sporidia simplicia, apicibus ramulorum innata iisdemque veluti pedicellata.

Spicaria solani. Floccis albis, decumbentibus dense intertextis, ramulis fertilibus vulgo quatuor erectis, sporidiis minimis ovalibus."

It is clear from the above and especially from the figures kindly supplied by Dr. Quanjer, that the genus *Spicaria*, as founded by Harting, on *S. solani*, does not correspond with the generally accepted views of the genus, which, according to Saccardo (Sylloge Fungorum iv. p. 167), are rightly interpreted by Harz (Bull. Imp. Natur., Moscow. xliv. 1, p. 167. 1871). *S. solani*, as described by Harting, would appear to belong not to the Mucedineae, as commonly supposed, but to Tuberculariеae. The figures suggest that *S. solani* is closely related to the genus *Tubercularia*, if indeed it should not be referred to it.

As the fungus isolated from the Skin Spot bears spores in

chains, which are formed acropetally, it must be placed in the section *Oosporeae*, and Miss E. M. Wakefield, who examined my cultures and material suggests that it would be most suitably placed in the genus *Oospora* itself, and that it must be regarded as an undescribed species. I am much indebted to her for assistance with regard to its systematic position, and for the following description:—

Oospora pustulans, *Owen & Wakef.* sp. nov.

Fungus filamentosus, sub epidermide pustulas minutas nigras efficiens. *Mycelium* repens, delicatulum; hyphae septatae primo hyalinae, 2-4 μ diametro, demum (in cultis) fuscae, torulosae, ad 5-7 (-10) μ diametro. *Conidiophora* erecta, curta, a mycelio haud distincta. *Conidia* cylindrica vel oblonga, hyalina, 6-12 × 2-2·5 μ, aetate provecta intus vacuolata, ideoque spurie 1- septata, in catenas longas plus minusve ramosas digesta.

Habitat: parasitic on tubers of *Solanum tuberosum*, forming minute pustules on the surface.

It should be noted that though the spore chains are sometimes branched, the branching is quite indefinite and the conidia arise directly from the hyphae without the intervention of a special swollen basal cell, as occurs in the section Aspergilleae. In very vigorous cultures the chain of spores are sometimes repeatedly branched and spread out in a fan-like manner.

The discovery of a fungus belonging to the genus *Oospora* at once recalls Thaxter's well-known *Oospora scabies*, the name long given to the organism causing common potato scab. A detailed account of this organism has been given by Lutman and Cunningham (Vermont Agric. Expt. Station. Bull. 184, 1914), where Thaxter's original description is quoted. It will at once be seen that the present organism differs in the possession of much larger hyphae and in the oblong spores borne in chains. Thaxter's plant is in fact not an *Oospora*, and is now generally regarded as belonging to the genus *Actinomyces*.

Inoculation Experiments.

All experiments dealing with the relation of *Oospora pustulans* to its host are much handicapped by the slow development of the fungus. The results of inoculations made under field-conditions in the early summer were not obtained till the following winter or early spring, and it will be necessary to wait another season before the results can be confirmed or amplified.

Two laboratory experiments made with freshly dug tubers of an early variety during June, 1918, may first be described. In order to accelerate the development of the spots, tubers inoculated with spores and placed on damp blotting paper in a large petri dish were kept in an incubator at 22° C. Under these conditions, however, the tubers did not remain normal. The lenticel tissues grew out, and straggly shoots developed from the eyes. At the end of three months there was no obvious sign of infection and the tubers were placed in a dark cellar, being examined periodically, with no results until early in April, when one or two isolated spots were found. In the light of the previous tests,

the general failure of this experiment was probably partly due to the high temperature of the incubator. The other set of experiments in the laboratory was made at ordinary room temperature. A few tubers inoculated in a similar way to the last and at the same time, were placed in a dark cupboard immediately after inoculation. On examining again after some weeks, one of the tubers was observed to be covered with a low-growing white mould. The mould proved to be *Oospora pustulans*. Later examination of the same tubers showed that the white growth had disappeared and its only effect on the tuber was a large brown patch on the skin. The discoloration did not penetrate through the skin to the flesh, and there were no signs of the development of the normal "Skin Spot." This experiment indicates that under very damp and warm conditions the fungus might possibly spread in the clamp without necessarily infecting the tubers, and that certain obscure markings on the skin of potato tubers might be due to injuries caused by *Oospora pustulans*.

Experiments were also carried out on living plants during the growing season, June-August. Inoculations were made on young tubers of potato plants growing in the experimental ground at Kew. In the first set "Midlothian Early" was selected, and the inoculations were made at the beginning of June. The soil was drawn away from the plants until a number of young tubers of different sizes were exposed, and the tubers were sprayed with a concentrated solution of spores of *Oospora pustulans* in sterile water. The soil was then replaced and the plants marked, and a similar number of other plants selected as controls. On lifting the plants in late summer no sign of Skin Spot was present, and examination during the winter gave a similar result. It may be noted that there are as yet no records of early varieties being attacked by this disease, though this may be partly accounted for by their earlier consumption.

The remaining cases inoculated were the late varieties "Provost," "The Ally," and "Secundus." The inoculations were made at the end of July, but that date appeared to be somewhat early, as few tubers had developed. About 4-8 young tubers were inoculated on about 6-8 plants of each variety, and a similar number of uninoculated plants were regarded as controls. The weather at that time was hot and dry and on the first few evenings after inoculation the plants were watered. The dry weather, however, continued for some time and it may perhaps account for the small amount of infection that resulted. At the time of lifting no trace of Skin Spot in any of the three varieties was evident. Much blight was present, and a large number of the tubers had to be discarded. The remainder were stored in a cellar and examined at intervals. No very definite spots developed during the winter. Early in April a few positive results were obtained in the case of both "The Ally" and "Provost." The number of tubers that developed the typical Skin Spot was in each case small, and the infection slight except in the case of one tuber of the "Provost." In this case the spots were crowded together into a circular area as is often the case in normal infection. To confirm the identity of the parasite,

cultures from this tuber were taken in the usual way, and a growth of typical *Oospora pustulans* was obtained. No definite results were obtained from "Secundus," nor were any of the controls affected. It should be noted that had it not been for the large number of tubers destroyed by blight an additional number of successful inoculations would probably have been obtained. One other set of experiments was conducted. Tubers of "Witch Hill" (an early variety) were, after lifting in late September, sprayed with spore solution and placed in the cellar in damp soil. Similarly treated, but unsprayed tubers, were kept as controls. At the end of three months the tubers were examined, but neither then nor later in April, was there any development of Skin Spot. It is desirable to repeat this experiment another season as it is most important to ascertain whether potato tubers may become infected after having been lifted and clamped.

Data which are being collected point to the greater susceptibility of some varieties than others (among which may be mentioned "King Edward," "Arran Chief," and "British Queen") and it is possible that the varieties used for inoculation purposes were more resistant than many others.

Possible Methods of Spread.

The following two sets of experiments were conducted in order to ascertain by what means the disease is carried from one season to another, and its method of spread in the soil.

The first set was carried out in pots. Clean tubers of "Midlothian Early," "Witch Hill," "British Queen," and "May Queen" were planted singly, at the end of April, in soil with which had been mixed peelings of diseased tubers. It was ascertained a few weeks later that the fungus was growing out from the inner side of the potato peelings, and was developing an abundant supply of spores. On examination in the autumn the tubers appeared clean, and in the following spring no spots were manifest, except on one small tuber of "May Queen."

The second series was conducted on the experimental ground at Kew, in a plot where the soil is a sticky silt. In order to test the possibility of the plants contaminating the soil a number of very badly infected tubers were planted in spring. The results showed that very little spread appears to take place during the first season, as on lifting in autumn, the crop was perfectly clean and no spots developed during winter. It should be noted, however, that though the blotches or pimples produced by this fungus are sometimes ruptured under artificial conditions, this does not take place naturally, so that in nature the fungus does not perhaps readily gain access to the soil, probably not until after the tubers decay. Should the soil be suitable for the fungus, in all probability tubers planted the following season would yield an infected crop.

Economic Importance of the Disease.

Since Skin Spot is a disease which develops in store and is not usually visible until the early spring, its economic importance might be expected to be slight. With regard to ware potatoes this is correct, for as its name implies, the diseased areas are for

the most part confined to the skin, and though the flesh of the tuber is penetrated to a slight extent by the fungus, it entails no appreciable waste in peeling. Beyond, therefore, rendering the tubers unsightly, and thus somewhat reducing their market value, this form of injury is not great.

In the case of seed potatoes, however, Skin Spot is of considerably more importance. When a crop in spring shows much infection, or the spots on the tubers are closely crowded together, there is a great danger of the eyes being injured. If the eyes are unaffected the shoots will grow and the plants will yield a normal healthy crop. This has been proved during two consecutive seasons at Kew. It should be remembered, however, that if the soil be suitable for the fungus it may become infected and future potato crops will be liable to suffer. On the other hand, where infection has taken place in the neighbourhood of the eyes, the eyes are definitely injured and even killed. This form of injury was stated to take place by Milburn, though no details as to the nature of the injury are given. It was also noted by Mr. F. T. Brooks and Miss A. D. Mackenzie, and also by Miss K. Sampson. Examination of tubers affected at the eyes shows that the fungus appears to penetrate, particularly deeply, the tissues around the eyes, and that in many cases relatively large areas of tissue may be killed. It has been observed by means of sections that the fungus at times not only kills the tissue around the eye, but also that immediately below it, *Oospora pustulans* has been isolated from a number of eyes killed in this way. As will be obvious from the earlier part of this paper, the details of infection were not ascertained, but there is no evidence at present that infection takes place more readily at the eyes than elsewhere. From these observations it would appear that Milburn's conclusion (p. 91, footnote) that it was the Skin Spot fungus which killed the eyes of several tons of "Evergood" was quite likely to be correct.

Although the primary eyes may be killed, it sometimes happens that secondary eyes may develop. Tubers of "King Edward," most of the eyes of which had been killed by *Oospora*, were placed in boxes to sprout in the usual way, and it was found that of the injured and killed eyes about 45 per cent. developed secondary eyes. Sections through some of these showed that the new buds had pushed their way through the dead tissue. This method of development has been described by Goebel (Einleitung in die Experimentelle Morphologie der Pflanzen. 1908. pp. 221-222). These new buds appeared to be fairly strong and their production affords an explanation of a phenomenon noted when badly spotted tubers were planted at Kew, namely, that all the tubers developed strong plants. On account of the check at the start, however, the plants would be later, and the yield perhaps somewhat less. Though these secondary eyes are undoubtedly developed fairly frequently, many eyes are killed outright, and if it can be avoided it is highly undesirable to plant badly spotted tubers. From the remarks made by Güssow (see p. 492), it is possible that the development of Skin Spot is favoured by bad ventilation during storage, but from observations made in England last year it is clear that Skin Spot is often entirely absent in very badly venti-

lated clamps, and that it sometimes develops in pits where the ventilation is at all events quite up to the average.

The evidence at present available points to the fact that Scotch seed is more affected than English seed, but the question as to whether this is the result of more generally affected soil, the nature of the season, or the methods of storage, must remain over for a future investigation.

Summary.

It is shown in the present paper that the disease of potato tubers known as Skin Spot is caused by a fungus belonging to the Hyphomycetes. The fungus is not *Spicaria solani* Harting as has been previously thought, but a minute species hitherto undescribed, which appears most suitably placed in the genus *Oospora*, and is described as a new species *O. pustulans*, Owen and Wakefield. The fungus grows readily as a saprophyte in culture, including agar and gelatine media, but more freely on sterilised vegetable tissues. The morphological characters of the fungus as seen in artificial cultures are described in detail.

Field inoculations with spores of the fungus were successful in a certain number of cases in producing the spot on the tubers, and the fungus was re-isolated from the affected tubers. Further work on the life history of the fungus is required, as it is not certain whether the tubers are infected in the soil only or also during storage. The exact type of soil and the conditions under which Skin Spot develops with special virulence are not yet clear.

With regard to the injury caused by the disease, the fungus is confined to the surface layers, and is often sharply isolated from the mass of the flesh by a layer of cork cells. Tubers, however, may be so severely spotted as to be greatly disfigured and to be depreciated in value. In addition to this it is shown that previous suppositions with regard to the injury caused by the fungus to the eyes were correct. When infection takes place in the neighbourhood of the eyes these are weakened or killed. In spite of the fact that in some cases secondary eyes are developed, seed tubers may undoubtedly be very seriously injured, when the fungus is present in quantity. The only preventive measure which can be recommended at present is to avoid planting diseased tubers. If badly affected tubers are planted, not only are "misses" likely to occur, but the soil is likely to be seriously affected with Skin Spot fungus.

Incidentally it is shown that the original description and figures of *Spicaria solani* on which Harting first founded the genus are at variance with the commonly accepted idea of the genus as framed by Harz.

In conclusion I should like to record my indebtedness to Mr. A. D. Cotton for his help and criticism during the course of this investigation.

I am also indebted to Mr. F. T. Brooks and Miss A. D. Mackenzie, who commenced a similar investigation at the Food Investigation Department of the Board of Agriculture, but who discontinued the work on learning that it was being carried out at Kew with better facilities.

XXII.—DOLICHANDRONE AND MARKHAMIA.

T. A. Sprague.

The name *Dolichandrone* was given in 1841 by Fenzl* to a group which contained two Australian Bignoniaceous trees, *Spathodea heterophylla*, R. Br., and *S. alternifolia*, R. Br., and which he treated as a section of the South American genus *Dolichandra*, Cham.

Seemann raised *Dolichandrone* to generic rank in 1862,† and quoted *Bignonia spathacea*, Linn. fil. as the type of the genus.‡ He subsequently published a generic description, and an enumeration of the species recognised by him.§ These included five Asiatic ones (*D. Rheedii*, *D. Lawii*, *D. falcata*, *D. crispa*, and *D. serrulata*), and two from Australia (*D. heterophylla* and *D. filiformis*).

The genus *Markhamia* was published in 1863 by Seemann‖ in a single line: "*Markhamia*, Seem. (type, *Spathodea stipulata*, Wall.). Asia trop." Seemann did not indicate how his new genus differed from *Dolichandrone*, nor did he ever supply a description of it.

In 1865 he described¶ the new genus *Muenteria*, which included two African species: *M. stenocarpa*, Seem., a new species collected by Welwitsch in Angola; and *M. tomentosa*, Seem. (*Spathodea tomentosa*, Benth.). He stated that *Muenteria* was allied to *Dolichandrone* and *Markhamia*, but did not mention how it differed from either. Five years later Seemann transferred *Spathodea lutea*, Benth., *S. zanzibarica*, Bojer, and *S. puberula*, Seem., to *Muenteria*.

Bentham reduced *Markhamia* and *Muenteria* to *Dolichandrone*, but recognised them as distinct sections.** K. Schumann restored *Markhamia* to generic rank and treated *Muenteria*, Seem., as a synonym, transferring to *Markhamia* all Seemann's species of *Muenteria*, and describing two additional ones.†† He stated that the capsule of *Dolichandrone* was quadrilocular owing to the presence of a false septum, which was absent in *Markhamia*; but this distinction between the two genera is not borne out by examination of herbarium specimens: an incomplete false septum exists in both genera.

The corolla, however, affords characters which amply justify the treatment of *Markhamia* as a separate genus. In both genera the corolla-tube is more or less funnel-shaped: in *Dolichandrone*, however, the lower and cylindric part of the tube is greatly

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* Darstell. und Erläut. p. 113 (Denkschr. Baier. Bot. Ges. Regensb. vol. iii. p. 265).

† Ann. Mag. Nat. Hist., ser. 3, vol. x. p. 31.

‡ Journ. Bot. 1863, p. 226.

§ l.c. 1870, p. 379.

‖ l.c. 1863, p. 226.

¶ l.c. 1865, p. 329.

** Gen. Plant. vol. ii. p. 1046.

†† Engl. u. Prantl. Nat. Pflanzenfam. vol. iv. 3 B, pp. 229, 242; Engl. Pflanzenw. Ost-Afr. vol. C, p. 363.

developed, and much exceeds the calyx, and the limb is almost actinomorphic; whereas in *Markhamia* the cylindric part of the tube is very short and concealed in the calyx, only the upper part of the funnel being visible, and the limb is conspicuously bilabiate. In addition, *Dolichandrone* has pure white, fragrant flowers which are open during the night, whilst those of *Markhamia* are yellow (rarely pink or lilac), or have a yellowish tube, spotted with purple, and brown-purple lobes, and expand in the daytime. Roxburgh says of *D. crispa*: "the large pure white fragrant flowers . . . expand in the evening and drop in the morning."* Wight states that those of *D. arcuata* usually expand in the evening and drop off in the morning,† and Ridley describes the flower of *D. Rheedii*‡ as "white, with a long tube, and a spreading circle of petals, and very fragrant, scenting the air deliciously in the early morning. The flowers are nocturnal, apparently opening after dark and commencing to fall by seven o'clock in the morning." The nocturnal expansion, white colour and powerful scent of the flowers, and the long, slender corolla-tube all point to the pollination of *Dolichandrone* by moths. No observations as to the pollination appear to have been published, and the genus is not mentioned in Knuth's Handbuch der Blütenbiologie.

It seems desirable to give an enumeration of the species referred to *Dolichandrone* and *Markhamia* respectively, as the synonymy is rather involved, and some of the species are not very well known.

Dolichandrone, *Seem.* in Ann. Mag. Nat. Hist. ser. 3, vol. x. p. 31 (1862); in Journ. Bot. 1863, p. 226; et l.c. 1870, p. 379; Benth. et Hook. f. Gen. Plant. vol. ii. p. 1046, partim (sectionibus *Markhamia* et *Muenteria* exclusis); K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3 B, p. 75.—*Spathodea*, R. Br. Prodr. p. 471; Bureau, Monogr. Bignon. p. 50; non Beauv. *Dolichandra*, sect. *Dolichandrone*, Fenzl in Denkschr. Baier. Bot. Ges. Regensburg, vol. iii. p. 265 (1841).

A. *Species australianae.*

1. **D. alternifolia,** *Seem.* in Journ. Bot. 1870, p. 340; Bailey, Class. Index Pl. Queensl. p. 29 (1883); Queensl. Fl. p. 1135. *D. heterophylla*, F. Muell. Fragm. vol. iv. p. 149, partim; Seem. in Journ. Bot. 1870, p. 382, partim. *Spathodea alternifolia*, R. Br. Prodr. p. 472 (1810); DC. Prodr. vol. ix. p. 209; Benth. Fl. Austral. vol. iv. p. 538.

Distrib. Queensland.

F. Mueller and Seemann considered *D. alternifolia* as a mere form of *D. heterophylla*, but Bentham, followed by F. M. Bailey, treated it as a distinct species; and this seems to be the best course to adopt in the present state of our knowledge. The Queensland specimens quoted by Bentham under *D. heterophylla*

* Fl. Ind. vol. iii. p. 104.

† Wight Ic. vol. iv. pt. 2, p. 9.

‡ Journ. As. Soc. Straits, no. 59, p. 40.

(Rockingham Bay, *Dallachy;* between Cleveland Bay and Rockingham Bay, *Hill*) should, however, in the writer's opinion, be referred to *D. alternifolia.*

2. **D. heterophylla,** *F. Muell.* Fragm. vol. iv. p. 149 (1864), in obs., excl. syn.; Seem. in Journ. Bot. 1870, p. 382; Bailey Queensl. Fl. p. 1135; Ewart et Davies. Fl. Northern Terr. p. 250. *Spathodea heterophylla,* R. Br. Prodr. p. 472 (1810); DC. Prodr. vol. ix. p. 207; Benth. Fl. Austral. vol. iv. p. 538.
Distrib. Northern Australia.

3. **D. filiformis,** *F. Muell.* Fragm. vol. iv. p. 149 (1864), in obs.; Seem. in Journ. Bot. 1870, p. 383; Ewart et Davies, Fl. Northern Terr. p. 250. *Bignonia filiformis,* A. Cunn. ex DC. in Ann. Sc. Nat. ser. 2, vol. xi. p. 286 (1839), nomen. *Spathodea filiformis* DC. Prodr. vol. ix. p. 209 (1845); Benth. Fl. Austral. vol. iv. p. 539.
Distrib. Northern Australia.

B. *Species asiaticae.*

4. **D. spathacea,** *K. Schum.* Fl. Kaiser Wilhelms Land, p. 123 (1889); K. Schum et Lauterb. Fl. Deutsch, Sudsee, p. 540; Schimper, Indomal. Standfl. p. 129; Whitford in Philipp. Journ. Sc. vol. i. p. 674; Merrill, Fl. Manila, p. 429; Merrill, Interpr. Rumph. Herb. Amboin. p. 469; Merrill, Spec. Blancoan. p. 349. *D. Rheedii,* Seem. in Journ. Bot. 1870, p. 380; C. B. Clarke in Hook. f. Fl. Brit. Ind. vol. iv. p. 379; Ridl. in Trans. Linn. Soc., Bot., vol. iii. p. 327; et in Journ. As. Soc. Straits, no. 33, p. 120; Trimen Fl. Ceylon, vol. iii. p. 282; Gamble, Man. Ind. Timb. ed. 2, p. 512; King et Gamble, Mat. Fl. Mal. Penins. Gamopet. p. 377; Brandis, Indian Trees, p. 494; Watt, Dict. Econ. Prod. India, vol. iii. p. 174; Koorders in Meded's Lands Plantent. vol. xix. p. 552; Boerl. Handl. Fl. Ned. Ind vol. ii. p. 600; Prain in Rec. Bot. Surv. India, vol. ii. pp. 246, 247, 326; Bourdillon, For. Trees Travancore p. 275; Guillaumin in Ann. Mus. Col. Marseille, 1911, ser. 2, vol. ix. p. 204; Ridl. in Kew Bull. 1910, p. 203; Ridl. in Journ. As Soc. Straits, No. 59, pp. 40, 146 (1911). *D. longissima,* K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3 B, p. 240 (1894); Koord. Exkursionsfl. Java, vol. iii. p. 184. *Bignonia spathacea,* Linn. f. Suppl. p. 283 (1781); Retz. Obs. Bot. fasc. v. p. 5; Willd. Sp. Pl. vol. iii. p. 304; Blanco, Fl. Filip. p. 499. *B. longissima,* Lour. Fl. Cochinch. p. 380 (1790). *B. longiflora,* Willd. ex DC. Prodr. vol. ix. p. 206 (1845), in syn. *Spathodea Rheedei,* Spreng. Syst. vol. ii. p. 835 (1825), quoad syn.; Wall. Cat. n. 6516; DC. Prodr. vol. ix. p. 206; Miq. Fl. Ned. Ind. vol. ii. p. 754; Wight, Ic. t. 1339; Beddome, For. Man. p. clxviii.; Kurz, Rep. Veg. Andaman Isl. p. 43; Kurz in Journ. As. Soc. Beng. vol. xlv. p. 142; Kurz, For. Fl. Brit. Burma, vol. ii. p. 234. *S longiflora,* Vent. Choix, p. 40 (1803); Pers. Syn. vol. ii. p. 173; Decne in Nouv. Ann. Mus. Hist. Nat. Par. 1834, vol. iii. p. 380; Span. in Linnaea, 1841, vol. xv. p. 326. *S. rostrata,* Span. l.c., in syn. *S. grandiflora,* Zipp. ex

Span. l.c., in syn. *S. Loureiriana*, DC. Prodr. vol. ix. p. 209 (1845). *S. luzonica*, Blanco, Fl. Filip. ed. 2, p. 350 (1845); ed. 3, vol. ii. p. 284, t. 242. *S. Diepenhorstii*, Miq. Fl. Ned. Ind. vol. ii. p. 754 (1856-59). *S. macroloba*, Miq. l.c. Suppl. p. 565 (1860). Niir Pongelion, Rheede, Horto. Malab. vol. vi. p. 53, t. 29 (1686). Lignum equinum, Rumph. Herb. Amboin. vol. iii. p. 73, t. 46 (1750).

Distrib. Malabar, Travancore, Ceylon, Sundribuns, Lower Burma, Andaman and Nicobar Islands, Malay Peninsula, Sumatra, Java, Timor, Philippines, Borneo, Celebes, Amboina, New Guinea, Solomon Islands, New Caledonia.

Dolichandrone spathacea seems to be mainly a coastal tree.* According to Beddome, it is common about Tellicherry and elsewhere in the plains of Malabar; it is found on the banks of rivers in Northern Travancore (Bourdillon); in Ceylon it occurs in moist low country, chiefly near the coast, and especially in mangrove swamps (Trimen); it is generally distributed in the Sundribuns, occurring both along the sea-face and in the swamp-forest (Prain). Ridley has recorded it from mangrove swamps and tidal rivers in the Malay Peninsula. It is very common in Java, but is confined to saline ground in the neighbourhood of the coast, and is especially frequent in mangrove swamps (Koorders). According to Merrill, it is widely distributed on the sea-shore and along tidal streams in the Philippine Islands; and it occurs in similar situations in New Guinea (Schumann and Lauterbach). According to Comins, it grows by riversides in San Cristoval, Solomon Islands. The occurence of *D. spathacea* in rice fields near Kanga village, Lower Siam, is explained by Ridley as follows: "The tree is about 60 ft. tall, and is the commonest one in the paddy fields. Doubtless it is one of the relics of the time when the whole of this country was a tidal swamp, gradually filling up after the disappearance of the sea, which overlay all this area. There are several more seashore plants still scattered over the paddy fields, such as the sand-spurge, *Euphorbia Atoto*."

Writing of the origin of the Sundribun flora, Prain mentioned *D. spathacea* as "the only swamp-forest tree for which introduction by wind seems unequivocal," and included it in a list of species which owe their presence at the sea-face of the Sundribuns to some agency other than that of ocean currents. Whilst its local dissemination is no doubt effected to a large extent by wind, the following considerations suggest that dispersal by means of ocean currents may also take place.

The seeds of *D. spathacea* are peculiar in having comparatively short opaque wings of a spongy texture similar to that of the body of the seed, and which has been termed "corky" by Clarke and other authors. The wings of the other species, and of most bignoniaceous seeds, are as long as or longer than the body of the seed, and very thin and hyaline. In these respects the seeds of *D. spathacea* are at the same time worse adapted for transport over long distances by wind, and better adapted for dispersal by

* The records from the interior of Burma are apparently referable to *D. serrulata*.

means of ocean currents. Taking into account also the littoral habitat of *D. spathacea*, and the considerable distances oversea separating various parts of its area of distribution, it seems not unlikely that ocean currents may have played some part in the wide dissemination of the species, although direct evidence of this is up to the present lacking.

5. **D. serrulata,** *Seem.* in Journ. Bot. 1870, p. 383, emend. (specimine ex India centrali excluso); affinis *D. spathaceae*, K. Schum., a qua foliolis minoribus brevius acuminatis, corollae tubi parte superiore longiore, capsulae septo crasso suberoso, seminum alis membranaceis differt.

Arbor 9-15 m. alta (fide *Witt*). Folia 8-22 cm. longa, 2-5-juga; foliola elliptica vel elliptico-oblonga, rarius obovata, 3-8 cm. longa, 1·5-4·5 cm. lata, basi (lateralia inaequaliter) cuneata, in cuspidem 4-6 mm. longam acutam acuminata, integra vel supra medium dentata, supra praesertim versus petiolulum minute lepidota; terminale 5-24 mm. petiolulatum; lateralia 1-10 mm. petiolulata. *Corollae tubus* 11-13 cm. longus; pars superior 5-6 cm. longus. *Capsula* sectione transversa rectangulari, 7-8 dm. longa, 1-1·5 cm. lata, 4-6 mm. crassa; septum crassum, suberosum. *Semina* 2·5-3·5 cm. longa, alis membranaceis.—*Dolichandrone*, n. 7, Brandis, Indian Trees, p. 494 (1906). *D. Rheedii*, Craib in Kew Bull. 1911, p. 433, non Seem. *Bignonia serrulata*, Wall. ex DC. in Bibl. Univ. Genèv. vol. xvii. p. 124 (1838); et in Ann. Sc. Nat., Ser. 2, vol. xi. p. 286 (1839). *B. laeta*, Wall. Cat. n. 6505 (1832); DC. Prodr. vol. ix. p. 171. *Bignonia* foliis pinnatis, floribus maximis, fere spithamaeis infundibuliformibus sub-2-labiatis laciniis crispatis. Griff. Priv. Journ. p. 148 (1847). *Spathodea serrulata*, DC. Prodr. vol. ix p. 206 (1845). *Stereospermum serrulatum*, DC., l.c. in syn.; Kurz, For. Fl. Brit. Burma, vol. ii. p. 230 (1877).

Distrib. Burma: Irrawaddy valley; Shwebo district, *Smales*; Thabet Kyin, *J. W. Oliver* (fide Brandis, l.c.); hills opposite Pagam, *Wallich;* Thayet Myo, *Griffith* (ex Priv. Journ. p. 148); Prome, *Brandis* (fide *Brandis*, l.c.). Lower Siam: Paknampo, common in dry deciduous forest, *Witt.*

When in a flowering state *D. serrulata* bears a strong resemblance to *D. spathacea*, and has been referred to that species. This may perhaps account for the inland distribution in Burma attributed to *D. spathacea* (*Spathodea Rheedii*) by Kurz, who says that it is "not unfrequent in the lower and upper mixed forests from Prome and the Pegu Yomah down to Tenasserim"; but is is possible that the area of the two species overlap. Gage has recorded *D. Rheedii* as one of the more common and conspicuous trees in the fairly open deciduous forest covering the Nwamadaung range, Minbu District, Upper Burma; but it seems possible that the tree in question will prove to be *D. serrulata*. (Rec. Bot. Surv. India, vol. iii. p. 86).

The capsules of *D. serrulata* strongly resemble those of *Stereospermum*, so that, in the absence of flowers, it was formerly assigned to that genus.

6. **D. atrovirens,** *Sprague.—D. crispa,* Seem. in Journ. Bot. 1870, p. 381, excl. syn. nonnull.; C. B. Clarke in Hook. f. Fl. Brit. Ind. vol. iv. p. 379; Gamble, Man. Ind. Timb. ed. 2, p. 512; Brandis, Indian Trees, p. 494, fig. 174; Cooke, Fl. Bombay, vol. ii. p. 329; Talbot, For. Fl. Bombay, vol. ii. p. 308, fig. 436. *Bignonia atrovirens,* Heyne ex Roth, Nov. Sp. pp. 284, 402 (1821); et ex Wall. Cat. n. 6515 C. (1832). *B. crispa,* Ham. in Roxb. Fl. Ind. vol. iii. p. 103 (1832). *B. parviflora,* Hb. Madr. ex. Wall. Cat. n. 6517 B. (1832), in syn. *Spathodea atrovirens,* Spreng. Syst. vol. ii. p. 835 (1825). *S. crispa,* Wall. Cat. n. 6515 (1832); DC. Prodr. vol. ix. p. 206; Dalz. et Gibs. Bombay Fl. p. 160; Brandis, For. Fl. p. 350; Beddome, For. Man. p. clxviii. *S. crispa* var. *petiolulosa,* DC. Prodr. vol. ix. p. 206 (1845).

Distrib. Peninsular India: Belgaum, Dharwar, Mysore, Tinnivelly (Kutallum), Pondicherry. According to Beddome (l.c.), it is not uncommon in subalpine forests throughout the Madras Presidency.

The earliest name for this species is *Bignonia atrovirens,* Heyne, a co-type of which is preserved in the Wallichian Herbarium at Kew, under n. 6515 C. Clarke treated *B. atrovirens* as a synonym of *Dolichandrone falcata* in the Flora of British India, but subsequently identified it with *D. crispa* (MS. in Herb. Wallich). K. Schumann cannot be quoted as the authority for the combination *D. atrovirens* (Heyne), as he used the name for a different species, *D. falcata.* Roth's description of *Bignonia atrovirens* leaves no doubt that the specimen which Heyne sent him belonged to the softly pilose form of *D. crispa,* grown in the Calcutta Botanic Gardens from seeds sent from Mysore by Hamilton (Roxb. Fl. Ind. vol. iii. p. 103), and mentioned by C. B. Clarke (Fl. Brit. Ind. vol. iv. p. 380). This was distributed under Wall. Cat. n. 6515 A. The specimen of *B. atrovirens* sent by Heyne to Wallich belongs, on the other hand, to the glabrous form of the species.

7. **D. arcuata,** *C. B. Clarke* in Hook. f. Fl. Brit. Ind. vol. iv. p. 380 (1884); Gamble, Man. Ind. Timb. ed. 2 p. 513; Brandis, Indian Trees, p. 493. *D. crispa,* Seem. in Journ. Bot. 1870, p. 381, quoad syn. *Spathodea arcuata,* Wight Ic. t. 1340 (1850): Beddome, For. Man. p. clxix.

Distrib. Madras: Ootacamund and Coimbatore; Malabar: Palghat and Valiyar.

D. arcuata differs from *D. atrovirens* in the larger number (up to 11) of leaflets, which are elliptic and shortly or not at all cuspidate, the shorter petiolules, the rather longer calyx, and the larger corolla, with a wider tube and more coarsely undulate lobes. Specimens collected by Wight at Palghat and Valiyar in the Malabar district differ from typical *D. arcuata* in being relatively glabrous, and in the longer petiolules. Clarke referred the Palghat tree to *D. crispa,* but Wight did not distinguish it from *D. arcuata,* and Brandis referred it to the latter.

Beddome's specimen from the Kurnool hills, referred to *D. arcuata* by Clarke and Brandis may possibly belong to this

species, but the material is insufficient to determine it with certainty. It has velvety-pubescent 5-foliolate leaves, and reniform lateral leaflets, with petiolules 7-10 mm. long.

8. **D. falcata,** *Seem.* in Journ. Bot. 1870, p. 381; C. B. Clarke in Hook, f. Fl. Brit. Ind. vol. iv. p. 380, excl. syn. nonnull; Gamble, Man, Ind. Timb. ed. 2, p. 512; Watt, Dict. Econ. Prod. India, vol. iii. p. 174; Brandis, Indian Trees, p. 493, fig. 173; Cooke, Fl. Bombay, vol. ii. p. 329; Talbot, For. Fl. Bombay, vol. ii. p. 310; Haines, Trees Centr. Prov. p. 167. *D. Lawii,* Seem. in Journ. Bot. 1870, p. 380; C. B. Clarke in Hook. f. Fl. Brit. Ind. vol. iv. p. 380; Brandis, Indian Trees, p. 493; Prain, Bengal Pl. vol. ii. p. 789. *D. serrulata,* Seem. l.c. 383, quoad specimen ex India centrali tantum, excl. syn. *D. atrovirens,* K. Schum. in Engl. et Prantl, Nat Pflanzenfam. vol. iv. 3B. p. 240, sed non *Bignonia atrovirens,* Heyne. *D. crispa,* K. Schum. l.c. 240, fig 92A, non Seem. *Spathodea falcata,* Wall. Cat. n. 6517A (1832); DC. Prodr. vol. ix. p. 206, excl. syn. nonnull; Dalz. et Gibs. Bombay Fl. p. 160; Bedd. Fl. Sylv. t. 71; Brandis For. Fl. p. 350. *S. crispa,* Bureau, Monogr. Bignon. Atlas, p. 30, t. 27 (1864), non Wall. *Bignonia spathacea,* Roxb. Cor. Pl. vol. ii. p. 24, t. 144 (1798), non Linn.; Roxb. Fl. Ind. vol. iii. p. 103. *B. falcata,* König ex Roxb. l.c. in syn.

Distrib. India: Rajputana, Bundelkhand, Behar, Central Provinces, Berar, Konkan, Belgaum, Mysore, Madras. According to Beddome, l.c., it is common in most of the forests in the Madras Presidency.

The figure in Roxb. Cor. Pl. t. 144 is poor, especially as regards the shape of the corolla-lobes, but there seems to be no reason for supposing that the capsule belongs to a different species from the flowering branch, as stated by Clarke.

Dolichandrone Lawii appears to be merely a glabrous form of *D. falcata,* as suggested by Brandis. The variation in the indumentum is not correlated with the degree of curvature of the capsule.

C. *Species africana.*

9. **D. alba,** *Sprague.—Spathodea alba,* Sim, For. Fl. Port. E. Afr. pp. 92, 116, t. 75 (1909).

Distrib. Portuguese East Africa.

Sim's description and figure leave little doubt that *Spathodea alba* is really a *Dolichandrone.* The spathaceous calyx, the almost actinomorphic white corolla with a long slender cylindric tube and lobes with wavy margins, and the powerful perfume of the flowers all point to this genus, which was previously unknown from Africa. It may be useful to reproduce his description in a slightly modified form, as the work in which it was published is probably not accessible to many botanists.

Spathodea alba—Arbor parva. *Folia* opposita, imparipinnata; foliola 4-juga, subsessilia, ovata, obvata vel elliptica, 5-10 cm. longa, apice rotundata vel obtusa, integra, undulata, glabra. *Racemus* terminalis, usque 4·5 dm. longus, multiflorus. *Flores*

speciosi, albi, suaveolentes, tres tantum simul expansi. *Pedunculus* 5-10 mm. longus. *Calyx* 2-3 cm. longus, unilateraliter fissus. *Corollae tubus* 4-5 cm. longus, cylindricus; limbus rotatus; lobi 2·5 cm. longi, 2 cm. lati, marginibus undulatis. *Pistillum* gracile, 4 cm. longum. *Capsula* linearis, compressa, 3-6 dm. longa, 2-2·5 cm. lata, 2-3 mm. crassa, pubescens, polysperma. *Semina* 1 cm. longa, alis lateralibus inclusis 4 cm. lata.—A small tree, frequent in Lower Gaza, M'Chopes and Inhambane; also present in the forests of Magenja da Costa. So strongly scented that one administrador thought a perfume industry might arise to utilise it.

Vernacular names: Insanye (Gaza and Zuvalla); Dane, Madane or Idane (between Inharreme and Inhambane); Naguro (Quelimane District).

Yields a light grey, very equal timber, of good surface, better than *Trichilia*, less red; weight about 45 lbs.; rings about 12 mm. apart, with many intermediate pores; rays not visible. Valuable board timber, not bored. Bark thin, flaky. Sometimes a large tree.

Markhamia, *Seem.* in Journ. Bot. 1863, p. 226, sine descr.; K. Schum. in Engl. et Prantl, Nat Pflanzenfam. vol. iv. 3B, p. 242 (1895); Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 522. *Muenteria*, Seem. in Journ. Bot. 1865, p. 329; et l.c. 1870, pp. 211, 338; non Walp. (1846). *Dolichandrone*, sect. *Markhamia* et *Muenteria*, Benth. in Benth. et Hook. f. Gen. Plant. vol. iv. p. 1046 (1876).

The species of *Markhamia* fall into three very natural groups. In the first, which includes *M. stipulata*, *M. cauda-felina*, *M. lutea*, *M. platycalyx* and *M. Hildebrandtii*, the corolla is yellow, and the pseudo-stipules (*i.e.* the first pair of leaves of an axillary shoot, which simulate stipules) are foliaceous and orbicular.

The second group includes *M. sessilis*, *M. tomentosa* and *M. obtusifolia*, and is characterized by a yellow corolla and subulate pseudo-stipules. The third group contains *M. puberula*, *M. stenocarpa*, *M. zanzibarica* and *M. acuminata*. It differs from both the preceding groups in the brownish purple corolla-lobes and purple spotted tube; and has foliaceous, orbicular pseudo-stipules.

The nearest affinities of *Markhamia* are with *Heterophragma*, DC., which differs in its non-spathaceous, irregularly lobed calyx.

A. *Corolla lutea; pseudostipulae orbiculares.*

1. **M. stipulata,** *Seem.* in Journ. Bot. 1870, p. 341; K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242. *Bignonia stipulata*, Roxb. Hort. Beng. p. 47 (1814), nomen; Roxb. Fl. Ind. vol. iii. p. 108 (1832). *B. campanulata*, Ham. ex Wall. Cat. n. 6518A. *Spathodea stipulata*, Wall. Cat. n. 6518A; n. 6518D; n. 6518C, quoad specim. e Segaen; Wall. Pl. As. Rar. vol. iii. p. 20, t. 238 (1832); DC. Prodr. vol. ix p. 205; Kurz, Rep. Veg. Andaman Isl. p. 43; Kurz, For. Fl. vol. ii. p. 234. *S. campanulata*, Ham. ex Wall. Pl. As. Rar. vol. iii.

p. 20 (1832), non Beauv. *S. velutina*, Kurz in Journ. As Soc. Beng. vol. xlii. p. 90 (1873); Kurz, For. Fl. vol. ii. p. 235 (1877). *Dolichandrone stipulata*, Benth. ex C. B. Clarke in Hook. f. Fl. Brit. Ind. vol. iv. p. 379 (1884); Brandis, Indian Trees, p. 493; Gamble, Man. Ind. Timb. ed 2, p. 512; Watt, Dict. Econ. Prod. India, vol. iii. p. 174; Gage in Rec. Bot. Surv. India, vol. iii. p. 86.

Distrib. Upper and Lower Burma; Andaman Islands.

Corolla foetid but eaten (Brandis); limb yellow, tube dirty reddish outside.

According to Gage, l.c., *M. stipulata* is amongst the more common and conspicuous trees in the fairly open deciduous forest covering the Nwamadaung range, in the Minbu district of Upper Burma. Kurz states that it is "rather rare in the open and the drier upper mixed forests of the Pegu Yomah and Martaban, as far down as Rangoon; also Ava." The type of *Spathodea velutina*, Kurz, is not at Kew, but, judging from the description, it seems hardly separable from *M. stipulata*, even as a variety.

M. stipulata, var. **Kerrii,** *Sprague;* capsules densissime lanatis differt.—*M. stipulata*, Craib. in Kew Bull. 1911, p. 433.

Distrib. Siam: Lakon district; near Hang Sut, in deciduous jungle, 360 m., *Kerr* 1013.

A well-marked variety, or possibly a distinct species. As noted by Craib, the indumentum of the capsule resembles that of *M. cauda-felina*, but the capsule is broader, the seeds are larger and the flowers smaller than in that species.

The following specimens may be assigned provisionally to *M. stipulata* var. *Kerrii*, though the material does not admit of a complete comparison:

Yunnan: Red River valley, south of Mengtze, 900 m., *Henry* 10121; Szemao, on mountains, 1200 m., *Henry* 10121 A. Kwangsi: Lungchow, on plain, *Morse* 291. Tonkin: woods near Phuong Lam, *Balansa* 3796.

2. **M. cauda-felina,** *Craib* in Kew Bull. 1911, p. 433, in obs. *Spathodea cauda-felina*, Hance in Journ. Bot. 1872, p. 257; et l.c. 1874, p. 177. *Dolichandrone cauda-felina*, Benth. ex Hemsl. in Journ. Linn. Soc. Bot. vol. xxvi. p. 235 (1890).

Distrib. China: Hainan.

The flowers are the largest in the genus: corolla 12-14 cm. in diameter, limb sulphur-yellow, tube dirty yellowish red outside. According to Hance, the fresh flowers have a disagreeable smell, much like that of raw shrimps.

A specimen collected at Montufar, Albay, Luzon, Philippine Islands, by Vidal (No. 3398), has leaves rather resembling those of *M. cauda-felina*, but the flowers (which are unfortunately in the bud stage) seem rather smaller, and the indumentum of the calyx is finer than in that species. Vidal's specimen is mentioned as *Dolichandrone* sp. in Cat. Pl. Herb. Fl. For. Filip. p. 127 (1892).

3. **M. lutea,** *K. Schum.* in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242, quoad syn., excl. loc.; De Willd. et Durand, Reliq. Dewevr. p. 172; Sprague in Hook. Ic. Pl. sub. t. 2800; Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 525. *Spathodea lutea*, Benth. in Hook. Niger Fl. p. 461, quoad specim. e Fernando Po. *Muenteria lutea*, Seem. in Journ. Bot. 1870, pp. 211, 338, excl. specim. a Barter lect. *Dolichandrone lutea*, Benth. ex Hook. f. et Jacks. Ind. Kew. vol. i. p. 785 (1893).

Distrib. West Africa: Gold Coast, Cameroons, Fernando Po, Belgian Congo (fide De Wild. et Durand).

Corolla yellow (*Mann, Vogel*). A form with lilac corolla has been collected in the Gold Coast Colony by Mr. T. W. Brown.

4. **M. platycalyx,** *Sprague* in Hook. Ic. Pl. t. 2800 (1905); et in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 525. *Dolichandrone platycalyx*, Baker in Kew Bull. 1894, p. 30.

Distrib. Uganda; British East Africa.

An important timber tree, common and widely distributed in Uganda and British East Africa, where it is known respectively under the vernacular names "Lusambia" and "Lusiola." According to Mahon (Herb. Kew.), it yields the finest of local timbers in the Entebbe district; and Moon (Herb. Kew.) states that in Kavirondo it forms a very fine timber tree, up to 70 ft. high; and that the wood takes a beautiful polish and is used by the natives for making stools and for hut slabs.

The corolla is of a rich yellow colour, with the lower lobes striped on the inside with red. (*Wilson.*)

5. **M. Hildebrandtii,** *Sprague* in Hook. Ic. Pl. t. 2800, fig. 9 (1905); et in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 526. *Dolichandrone Hildebrandtii*, Baker in Kew Bull. 1894, p. 31.

Distrib. British East Africa; Usambara.

Corolla yellow (*Hildebrandt*).

B. *Corolla lutea; pseudostipulae subulatae.*

6. **M. sessilis,** *Sprague* in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 526 (1906). *Muenteria tomentosa*, Seem. in Journ. Bot. 1865, p. 330, t. 35, quoad icon. et specim. angolens., excl. syn.; Seem. l.c. 1870, pp. 211, 338, quoad specim. angolens., excl. syn. *Markhamia tomentosa*, Hiern, Cat. Afr. Pl. Welw. vol. i. p. 772 (1900), non K. Schum.

Distrib. West Africa: Lower Congo; Angola.

Corolla yellow, with narrow reddish-purple stripes. (*Welwitsch.*)

M. sessilis, var. **brachyrhyncha,** *Sprague* in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 527 (1906).

Distrib. French Congo.

7. **M. tomentosa,** *K. Schum.* ex Engl. Glied. Veg. Usambara, p. 34 (1894), quoad syn. tantum; K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242, partim; Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 528; Wernham in Cat. Talbot's

Niger. Pl. p. 139. *Spathodea tomentosa*, Benth. in Hook. Niger Fl. p. 462 (1849). *S. lutea*, Benth. l.c. 461, quoad specim. nigericum. *Muenteria tomentosa*, Seem. in Journ. Bot. 1865, p. 330, quoad syn., excl. descr. icon. et specim. angolens.; *M. lutea*, Seem. l.c. 1870, pp. 211, 338, quoad Barter 555. *Dolichandrone tomentosa*, Benth. ex Hook. f. et Jacks. Ind. Kew. vol. i. p. 785 (1893).

Distrib. West Africa: from Senegambia to the Cameroons.

Corolla usually yellow. A form with a rose-coloured corolla has been collected in Spanish Guinea by Tessman.

M. tomentosa, var. **gracilis,** *Sprague* in Dyer Fl. Trob. Afr. vol. iv. pt. 2, p. 528 (1906). *Muenteria lutea*, Seem. in Journ. Bot. 1870, pp. 211, 338, quoad Barter 1310.

Distrib. Northern Nigeria: Nupe, *Barter* 1310.

A very distinct-looking variety, differing from the type in the smaller, very shortly cuspidate calyx. The corolla is golden, with reddish stripes (*Barter*).

8. **M. obtusifolia,** *Sprague.*—*M. lanata*, K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242 (1895); Sprague in Hook. Ic. Pl. t. 2800, fig. 8; et in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 527; S. Moore et Swynnerton in Journ. Linn. Soc., Bot., vol. xl. p. 155. *M. tomentosa*, K. Schum. in Engl. Glied. Veg. Usambara, pp. 34, 49 (1894), quoad descr. et loc., excl. syn.; et in Engl. Jahrb. vol. xxviii. p. 480. *M. paucifoliolata*, De Wild. Etudes Fl. Katanga, p. 131 (1903). *M. Verdickii*, De Wild. l.c. 132 (1903). *Dolichandrone obtusifolia*, Baker in Kew Bull. 1894, p. 31.

Distrib. Belgian Congo, British Central Africa, Rhodesia, and East Africa, from Usambara to the Zambesi.

The earliest name for the species is *Dolichandrone obtusifolia*, Baker (1894). In Nyasaland and Gazaland it is a tree 6-9 m. high, (*Purves*, *Swynnerton*), on the lower Shire river and lower Zambesi river, a shrub 1·5-4·5 m. high (*Kirk*), and near the Victoria Falls, a bushy tree 1·8-2·4 m. high, growing on granite sand (*Sykes*). According to Swynnerton, l.c., it is known by the vernacular (Chindao) name "Mubfeya" in Gazaland, where the wood is a favourite with native bowyers, the bark is employed as a substitute for rope, and a decoction of the roots is said to be used for fever and colic.

The corolla is yellow, striped with chocolate (*Purves*).

C. *Corollae lobi brunneo-purpurei; pseudostipulae orbiculares.*

9. **M. puberula,** *K. Schum.* in Engl. et Prantl, Nat. Pflanzenfam. vol. iv 3B, p. 242 (1895): in Engl. Jahrb. vol. xxviii. p. 480; et in Engl. Pfl. Ost-Afr. vol. C, p. 363; Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 523. *Spathodea puberula*, Klotzsch in Peters, Reise, Mossamb. Bot. p. 192 (1861). *Muenteria puberula*, Seem. in Journ. Bot. 1870, pp. 212, 339. *Dolichandrone hirsuta*, Baker in Kew Bull. 1894, p. 31.

Distrib. East Africa, from Uluguru to the Lower Zambesi.

Corolla-lobes brownish purple; tube purple-spotted.

10. **M. stenocarpa,** *K. Schum.* in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242 (1895); Hiern, Cat. Welw. Afr. Pl. vol. i. p. 791; Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 523. *Muenteria stenocarpa*, Seem. in Journ. Bot. 1865, p. 329, t. 36, excl. specim. a Kirk lect. *Spathodea stenocarpa*, Welw. ex Seem. l.c. *Dolichandrone stenocarpa*, Baker in Kew Bull. 1894, p. 31.

Distrib. Angola.

Corolla greenish sulphur in colour outside, deep sulphur inside, marked with longitudinal dark purple lines and spots; lobes dusky purple inside (*Welwitsch* 483); corolla white or yellow, variegated with a rose or violet colour (*Welwitsch* 482).

11. **M. zanzibarica,** *K. Schum.* ex Engl. Glied. Veg. Usambara, pp. 34, 36 (1894); et in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242; Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 523. *M. zanzibarica*, K. Schum. ex Engl. Glied. Veg. Usambara, p. 16 (1894); in Engl. Pfl. Ost-Afr. vol. C, p. 363; et in Engl. Jahrb. vol. xxxiii. p. 332. *Spathodea tenuifolia*, Bojer, Hort. Maurit. p. 219 (1837), nomen. *S. zanzibarica*, Bojer ex DC. Prodr. vol. ix. p. 208 (1845); Kiotzsch in Peters, Reise Mossamb. Bot. p. 191. *Muenteria zanzibarica*, Seem. in Journ. Bot. 1870, p. 339. *Dolichandrone latifolia*, Baker in Kew Bull. 1894, p. 31.

Distrib. East Africa, from Mombasa to Mozambique.

There is an excellent coloured drawing of *M. zanzibarica* in the Kew collection. It was received without a name from L. Bouton in 1863; on the other side of the same cardboard was an uncoloured drawing of *Phyllarthron Bojerianum*, DC., endorsed "Phyllarthron Bojerianum, DC. Prod. Hab. in Ins. Madagascar. Cult. in Ins. Maur." These two drawings were probably executed by Bojer from the living shrub and tree, cultivated at Pamplemousse, and included in his Hortus Mauritianus pp. 219, 221 (1837) under the names *Spathodea tenuifolia*, Boj., and *Arthrophyllum madagascariense*, Boj., respectively. Bojer appears to have sent specimens of *Markhamia zanzibarica* to De Candolle on two occasions: in 1831 under the name *Spathodea zanbibarica*, and in 1839 as *Spathodea tenuifolia*. De Candolle adopted the former name in the ninth volume of the Prodromus, and the effective publication of the species dates from that work, since no description was given of *S. tenuifolia* in the Hortus Mauritianus.

In Zanzibar *M. zanzibaricus* occurs as a shrub 3 m. high on the slopes of coral-limestone hills (*Hildebrandt*); in the coast region of British East Africa it is a small tree, rarely exceeding 9 m. in height (*Battiscombe*). The corolla-tube is buff-coloured with brownish purple spots, and the lobes are brownish purple.

12. **M. acuminata,** *K. Schum.* in Engl. Pfl. Ost-Afr. vol. C. p. 363 (1895); Sprague in Dyer, Fl. Trop. Afr. vol. iv. pt. 2, p. 524; N. E. Brown in Kew Bull. 1909, p. 126; Swynnerton et S. Moore in Journ. Linn. Soc., Bot. vol. xl. p. 155. *M. infundibuliformis*, K. Schum. in Engl. et Prantl, Nat. Pflanzenfam. vol. iv. 3B, p. 242 (1895); et in Engl. Pfl. Ost-Afr. vol. C, p. 363.

Spathodea acuminata, Klotzsch in Peters, Reise Mossamb. Bot. p. 191 (1861). *Muenteria stenocarpa*, Seem. in Journ. Bot. 1865, p. 329, quoad specim. a Kirk lect. .

Distrib. East Africa, from Msalala to the Lower Zambesi, Rhodesia, Ngamiland and Transvaal (Zoutpansberg District).

M. acuminata is described as a shrub (*Peters*, *Foye*), or a small tree (*Johnson*, *Swynnerton*). In Ngamiland, according to Lugard, it is a tree 3-3·5 m. high, and "never seems to attain a girth beyond a few inches." On an island near the Victoria Falls, it attains a height of 6-7·5 m., according to Allen.

In Gazaland it is known by the vernacular (Chindao) name "Musiramyati," and yields a durable timber used for rafters, etc. (*Swynnerton*). The known distribution of *M. acuminata* has been extended southwards by its discovery in the Zoutpansberg District of the Transvaal by Mr. J. Foye, who has communicated the following note on its occurrence, through the Division of Botany, Department of Agriculture, Pretoria.

"The situation where this shrub grows is at the base, and on the granite koppies that encircle Messina mine to the south-east like an amphitheatre, a quarter of a mile or so away from the koppies; the shrub is but rarely met with beyond this distance: on the deeper red soil of the flats I have not yet seen a single specimen; it also grows on or about the koppie to the north of the mine of the Messina Company named 'Vogellanzang.' There may of course be many other places, but the above are all that are known to me. One thing I feel pretty sure about, that away from rocky situations it will not be found."

The corolla-lobes are brownish-purple or maroon, and the tube is yellow or buff-coloured with brownish purple spots. The capsule is sometimes 9 dm. long (*Johnson*). A copy of a water-colour drawing by Mrs. E. J. Lugard is contained in the Kew collection.

XXIII.—MISCELLANEOUS NOTES.

George Stephen West.—We have to record, with great regret, the death of Professor G. S. West, D.Sc., M.A., A.R.C.S., F.L.S., which took place on August 7th last, after only a short illness, but he had been in indifferent health for some considerable time. He was Mason Professor of Botany at the University of Birmingham, a post which he had filled with great distinction for ten years, having previously been lecturer under his predecessor, Professor W. Hillhouse. His chief pursuit was the study of Freshwater Algae from all parts of the world, especially of the Diatoms and Desmids, in the latter of which he made for himself an unequalled name: he knew at first sight nearly every British Desmid, and a large proportion of the exotic ones.

He was an excellent lecturer and teacher, much admired and respected by his pupils; he managed his department with great success, and had gathered round him a band of students who

were inspired by his example, especially the post-graduate students who investigated such subjects as the Algae of the soil, and the forms of the chloroplasts of Desmids, in both of which they made unexpected discoveries. His chief works, besides numerous contributions to periodicals on Algae from every country, were the four volumes on British Desmids, published by the Ray Society, a treatise on the British Freshwater Algae, published in 1904, and the first volume of the Cambridge Botanical Handbooks, which treats of the Chlorophyceae and allied forms (1916). He had intended to follow up the latter by a work in which all the British species of Freshwater Algae (excluding the Diatoms and Desmids) should be adequately described and illustrated; part of this is already done, and those who knew Professor West's accuracy and zeal were looking forward to a volume which should rescue this branch of the science from the low level to which it had sunk through previous attempts. His premature decease at the early age of 43 is a loss to Algology which will not easily be repaired, and it is to be hoped that that portion of his work which is completed, but unpublished, will not be allowed to perish. W. B. G.

Retirement of Museum Preparer.—In May of the present year, Mr. George Badderly, for 39 years preparer in the Museums, retired when within a few days of the completion of his 81st year. His early life was spent at Berkhamsted, where he served his apprenticeship as a carpenter. On leaving Berkhamsted he spent several years at carpentry and cabinet work with leading London firms, and was then appointed a preparer at the India Museum. When the India Museum collections were transferred to Kew Badderly came with them, commencing his new duties on April 1st, 1880. On the completion of the North Gallery, he assisted Miss North in the arrangement and mounting of the pictures, afterwards occupying the adjoining residence with his wife, who acted as the official caretaker until within a few months of her death in 1915. Throughout the whole of this time they were held in high esteem by officials and visitors. After his wife's death Badderly wished to retire, but owing to the war the difficulty of filling his place was so great that he consented to carry on his duties until the present year. An example of the best type of British workman, clever, careful and painstaking, Badderley has always been a perfect master of his craft. His readiness to undertake difficult tasks and to impart his knowledge to others, together with his cheerful disposition, gained him the affection of everyone, and his retirement is a distinct loss to the establishment in which he served so long.

New Zealand Flax.—In the Annual Report of the New Zealand Department of Agriculture for 1908, pp. 405-412, an account is given of experiments conducted in the cultivation of the different varieties of New Zealand Flax or Hemp (*Phormium tenax*) with a view to ascertaining their respective

fibre values, and a summary of that report is given here as a continuation of the article on New Zealand Flax which appeared in *K.B.*, No. 4, 1919.

The varieties tested were as follows:—

Awanga.—An erect variety producing a strong heavy leaf with a thick, pulpy, white butt. The fibre is strong, coarse, and bright, easily stripped, washed and bleached. The colour of the finished fibre shows a marked difference to that of other varieties, except *Huhiroa*. The variety produces a heavy crop of leaves per acre, but the fibre yield per ton of green leaves is low. *Ngutunui.*—A variety highly prized by the natives and used by them for making the finer kinds of mats (shawls), the fibre being very strong and elastic. It is a drooping variety with a shorter leaf than some of the others. The leaf is thin with a red butt and is rather difficult to wash and bleach on account of the colour. The fibre is thin but strong and tough, and closely resembles the better qualities of Manila hemp. In point of strength it is by far the best of any tested. *Putaiore.*—This is an erect variety growing 8-10 ft. high, with an even leaf throughout, the butt or base being little thicker than the top. It gives a good return of fibre per ton of green leaf, multiplies quickly and throws up numerous shoots. *Whaririki.*—Of drooping habit, with a thin paper-like leaf, seldom more than 5 ft. long. The yield per acre of green leaf is very small. It produces a very fine, silky fibre, but is too easily bruised and broken in stripping. The fibre was graded the lowest on the list, owing to its bruised condition and lack of strength. The variety is generally known to the miller as "hill" or "mountain" hemp. With an improved method of stripping which would not break or injure the fibre it is considered that the fine silky nature of the fibre of this variety would make it equal, if not superior to other varieties tested for fine and high-class work. *Nguturua* or *Ngutuwahine.*—Grows with and closely resembles *Ngutunui*. The chief difference is seen on cutting the leaf, the butt of *Nguturua* being white and that of *Ngutunui* very red. The fibre of the former, although strong and fairly easily worked, does not compare with that of *Ngutunui* as far as strength is concerned. The fibre, being fine, is used by the natives for the finer kinds of shawls. *Katiraukawa.*—This is a slightly drooping variety, often 12 ft. high, resembling *Awanga*, except that the latter is an erect variety and is stronger and heavier at the butt, having more vegetation. The fibre resembles that of *Awanga*, but is finer and softer. The natives use it for the softer parts of the best mats, and in all kinds of work where fibre is used. *Huhiroa.*—Has strong, erect, dark green leaves, very pale on the under surface. It resembles the *Putaiore* in appearance, the leaf being narrow and of fairly even thickness throughout, but yielding less fibre. The fibre is highly prized by the natives and when stripped by their method it is very strong and bright, and is used in all their finer kinds of work. *Oue* (semi-bronze).—This has a very broad, thick leaf, not so pointed as the other varieties cultivated. The butt is very heavy and coarse, the fibre fine and silky, of medium colour, but defective

in strength. The variety is not recommended for commercial purposes. *Paretaniwha.*—A tall, erect variety 10 ft. high with a thick butt, bearing a good proportion of good, strong, coarse, free fibre. *Harakeke Parae.*—This is a strong-growing variety, most of the butts red, the leaf hard and somewhat difficult to strip and treat generally. It yields a fair percentage of fibre, but faulty in colour, harsh to the touch, and poor in strength.

The following table shows the quantity of green leaf required by each variety to produce one ton of fibre:—

	Tons.	cwt.	qr.	lb.
Awanga	10	11	1	8
Ngutunui	8	7	3	17
Putaiore	8	2	1	24
Harakeke Parae	8	11	0	11
Whararíki	8	4	2	23
Ngutuparua	8	15	2	20
Uncultivated	8	4	0	11
Katiraukawa	9	9	3	9
Oue	10	7	1	17
Huhiroa	8	12	1	6
Paretaniwha	8	19	0	22

In several cases the leaves were badly injured by fungi and caterpillars and the yield of fibre was reduced thereby.

In the Journal of the New Zealand Department of Agriculture, iii., July 15th, 1911, pp. 60-61, an account is given of a new variety raised by Mr. A. W. Green, of the Ruakura Experimental Farm, by crossing the varieties Awanga and Putaiore, which is said to possess great disease resisting properties and at the same time to yield a high percentage of medium quality fibre.

In 1872 descriptions of a large number of varieties were given in a pamphlet by Sir James Hector, entitled "Phormium tenax as a Fibrous Plant," pp. 1-134, prepared for the Colonial Museum and Survey Department: Second edition, pp. 1-95 (1889). Some of the varieties mentioned above are included in the older work, but several of them are not there recorded.

Variation in Hevea brasiliensis.—A paper of considerable importance and interest to those engaged in the Para rubber industry has been published in the "Annals of Botany," Vol. XXXIII., No. CXXXI., July 1919, p. 313, by Mr. Stafford Whitby, M.Sc., A.R.C.S., of McGill University, Montreal, Canada.

The paper embodies the results of the observations made by the author in the Federated Malay States as to the extent to which variation occurs in the amount of rubber yielded by individual trees of *Hevea brasiliensis* of the same age and growing under the same conditions. He also investigated the possible correlation between the yield of rubber and the girth of the trunk. Some 1000 trees, seven years old, in a normal plantation covering about 13 acres, were carefully studied, the trees being in their third year of tapping. As the Eastern plantations have been made with trees raised from non-selected seed, the results of the investigation are of particular interest. Great variations were found in the rubber content of the latex (the

"strength" of the latex) from different trees, and appeared to be constant and characteristic for the individual tree. Some trees yielded only 23 grms. of rubber per 100 c.c. of latex, while at the other extreme trees were found yielding as much as 54-55 grms. of rubber per 100 c.c. of latex, the mean for the 245 trees examined in this connection being 36·58 grms. per 100 c.c.

The author concludes from his observations on older trees, that as a tree grows older the rubber content of the latex yielded by it increases 1-2 per cent. per annum. The results are set out in tabular form, and while only relatively few trees show the lower percentages of from 23-29 grms. and the higher from 44-55 grms, the majority yield amounts varying from 30-43 grms.

With regard to yield of rubber, it was found that individual trees were comparatively constant and from observations extending over two years it is stated that a tree which was found to be a high yielder at one time could be relied upon to give a high yield at all times. The yield-results are summarised in a table and by means of a curve, and embody the examination of 1011 seven-year old trees.

The mean yield in grammes per day came to 7·12 grms., but some few trees yielded more than 27 grms. a day, and for a large number the yield was from 0-2 grms. Thus from 9·6 per cent. of the total number of trees 28 per cent. of the total yield was contributed, while 13·7 per cent. (0-2 grms. group) only gave 2·9 per cent. of the yield and certainly did not repay the cost of tapping. Four outstanding trees in the plantation gave 41·45, 41·56, 41·72 and 42·77 grms. per day.

The great possibilities of seed selection in improving rubber yield are very clearly indicated from these figures.

A further important observation in connection with seed selection to which Mr. Whitby draws attention is that the seeds from any one tree are exactly similar in appearance as regards tint, mottle pattern and shape.

It now remains to be seen whether seeds from a high-yielding tree will give rise to trees similar to the parent. This is hardly likely to be the case under present plantation conditions, where high and low-yielding trees are indiscriminately intermixed. But it does seem to be indicated that if high-yielding trees can be segregated, and provided that pollen of poor-yielding trees be prevented access to the flowers, seeds capable of producing trees yielding a high percentage of rubber would be assured.

The author also gives particulars of the correlation between yield and girth, which indicate that though there is a definite correlation—trees with a large trunk being good yielders and those with small trunks being poor yielders—it is not sufficiently well indicated to be of great value in eliminating trees from a plantation.

It is of interest to notice that A. A. L. Rutgers ("Selectie en Uitdunning," Archief voor de Rubber culturer, 1919, 3, pp. 105-123) has made observations in Sumatra in full accord with those of Mr. Whitby and finds that "good trees remain good, poor trees remain poor."

A. W. H.

Austrian Botanical Expedition to Southwest China.—The last of the preliminary reports of the Austrian Expedition to Southwest China, conducted by Camillo Schneider and Dr. H. Handel-Mazzetti, having come to hand, we are now able to give a short account of this enterprise which promises to add much to our knowledge of an area which has already yielded so many botanical treasures, thanks to the enthusiasm of the French Missionary Delavay and the untiring energy of George Forrest. The expedition was undertaken on behalf of the Dendrological Society, with the support of the Academy of Sciences of Vienna. It started from Yunnanfu in March, 1914, and had the mountain ranges of the Upper Yangtsekiang basin between 27° and 30° N. Lat. as its principal object, a plan which, however, was subsequently considerably modified. The ground covered by the work of 1914 may be briefly indicated by the following localities which can be traced in any large Atlas—Hweili-chou, Ningyanfu, Yenyuanhsien, Kwapi (28° N. Lat.; all these in the Yalung basin in Southern Szechuan), Yungning, Siachungtien, Likiang North East Yunnan). In July Schneider left for Talifu and eventually went to America, whilst Handel-Mazzetti continued the work for the next five years. He visited the southern corner of Szechuan a second time in the autumn of 1914. The early spring of 1915 saw him at Mengtze, Henry's collecting ground, and at Manhao on the Red River (South Yunnan). Then having returned to Yunnanfu he went over the Yunnan plateau to Likiang, Tschungtien, Weih-si, and crossed the Mekong near Tseku for the Doker-La to take up and supplement Forrest's work in that region. He finally penetrated as far as the watershed between the Salween and the Kiu-kiang, the easternmost feeder of the Irawaddi. Having spent the winter 1915-16 at Yunnanfu he went once more viâ Likiang to the Chinese portion of the upper Salween basin which he explored up to its western and northern boundaries. After another winter at Yunnanfu Handel-Mazzetti decided on a traverse of Kweichow and Hunan through botanically unexplored country. His route lay over Kweiyang, Tuyunfu, Kuchow and Lipingfu (Southeastern Kweichow), then Tsingchow, Wukangchow, Sinning, Yungchow, Hangchow to Changsha (all these in Hunan), where he spent the winter 1917-18. The following summer was devoted to the exploration of Central Southwest Hunan. The final preparation of his extensive collections occupied the winter 1918-19, and the early spring of the present year, Handel-Mazzetti leaving Changsha on the 25th March.

Handel-Mazzetti has travelled before in Kurdistan and Northern Mesopotamia, and won a reputation as botanical explorer and geographer. As he is moreover an experienced mountaineer and an excellent photographer, we may look forward to a rich harvest in botany and geography. A preliminary account of the floral zones and plant-formations of Yunnan and Southwest Szechuan was published in the Akademischer Anzeiger of the Vienna Academy for 6th July, 1916 (No. 18), and 22nd November, 1917 (No. 24), whilst a preliminary report on the vegetation of Kweichou and Hunan is in the press. The first deals with (A) the tropical region, studied by him in the

neighbourhood of Manhao on the Red River, (B) the Yunnan plateau (subtropical up to 6000 ft. and warm temperate: 6000-9500 ft.), (C) the High Mountains of Southwest Szechuan and North Yunnan (subtropical: 5000-8000, or locally 9000 ft.; warm-temperate: 8000 or locally 6200 to 8200, or in very dry situations 9500 ft.; temperate: 8200-12,500 ft.; cold-temperate: 12,000-14,600 ft.; high-alpine: 14,600-16,400 ft.), (D) the High Mountains of the Northeast Burma—West Yunnan frontier (warm-temperate: 6000-9000 or locally 10,800 ft.; temperate: 8200-11,500 ft.; cold-temperate: 11,500-13,800 on western slopes or 14,400 on eastern slopes; high-alpine: from 13,800-14,400 upwards). Among the most remarkable discoveries may be mentioned the Conifer *Taiwania cryptomeroides* (so far only known from Formosa) as far west as the Salween, a Cedar on the Mekong, *Juglans regia* wild on the Salween, a practically black-flowered *Rhododendron*, and a saprophytic chlorophyll-less orchid 8 ft. high. O. S.

Presentation of Early Water-Colour Drawings.—Prof. F. W. Oliver, F.R.S., has presented five interesting and very beautiful early water-colour drawings of flowers for exhibition with Sir Arthur Church's collection of drawings in the North Gallery (see *K.B.*, 1916, p. 162). These drawings come from the collection made by his father, the late Prof. Daniel Oliver, F.R.S., for many years keeper of the Herbarium.

Two are early works probably of the Dutch school, but the artist or artists are not known; they formed part of the Sunderland collection which was sold in 1883.

1. Is an unfinished study of Tulips and Double Anemones.
2. A study of three Anemones.

   The quality and tone of the paper adds greatly to the charm of these two fine drawings.
3. A group of Polyanthus and Primroses by Maria Sibylla Merian.*

   This and the following picture were in Lord Bute's collection and then in the Beale collection before they were acquired by Prof. D. Oliver.
4. A crimson *Senecio*, by Nicholas Juweel.†
5. *Fritillaria imperialis* with bulb, by an unknown artist, also from the Sunderland collection.

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* Merian, Maria Sibylla.—Daughter of Matthew Merian, the engraver, was born at Frankfort-on-Maine in 1647 and died at Amsterdam in 1717. She painted flowers and insects usually in water colour on vellum. Her work on European insects and the plants on which they feed went through several editions. Her most famous book was the folio illustration of the metamorphosis of Surinam insects with the trees on which they feed, and many of the plates she also engraved. She was in Surinam from 1699 to 1701. Her father's book, "Florilegium Renovatum et auctum," is well known. Two volumes of her drawings are preserved at the British Museum. Her husband, Johann Andreas Graffen, was also an artist.

† Juweel, Nicholas.—A painter of Rotterdam living in 1690 who imitated the manner of Chevalier van der Weiff.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 9] [1919

XXIV.—THE "JERUSALEM ARTICHOKE."

(*Helianthus tuberosus.*)

C. C. Lacaita.

In the Gardeners' Chronicle for March 23rd, 1918, vol. lxiii. p. 126, there appeared a paragraph offering prizes for a new English name for the Jerusalem artichoke, in which it was stated that "the name is considered a corruption of the Italian *Girasole Artiocco*, or Sunflower Artichoke, under which name it is said to have been originally distributed from the Farnese gardens at Rome in 1617." Now we may assert positively (1) that it was not originally distributed from the Farnese gardens; (2) that it was not called *Girasole Articiocco** in those gardens; (3) that it never has been known in Italy under that name.

The history of *Helianthus tuberosus*, L., the "Jerusalem Artichoke" has been dealt with in some detail by Schlechtendal, "Zur Geschichte des Helianthus tuberosus, L." in the Botanische Zeitung, of April 23rd, 1858, vol. xvi. p. 113; by Trumbull and Gray, "Notes on the History of *Helianthus tuberosus*" in Amer. Journ. of Science and Arts, 3rd series, xiii. p. 347 (1877); by Decaisne in Flore des Serres et des Jardins, xxiii. p. 112 (1880); by Gray and Trumbull again in their Review of De Candolle's Origin of Cultivated Plants in Am. Journ. of Science, 3rd series, xxv. p. 244 (1883); by Hooker in Bot. Mag., liii. t. 7545 (1897); and by Gibault, Histoire des Legumes, p. 286 (1912).

None of these accounts are complete, and all contain some inaccuracies; it has therefore seemed desirable to collect the information contained in them, and to supplement it with more details of the discovery and distribution of the plant, and a fuller discussion of the origin of the popular English and French names.

As far as can be traced, the Jerusalem artichoke was first noticed by Europeans during Champlain's second voyage, 1604-1607, when he saw it in cultivation on a visit to the habitations of the natives at Nauset Harbour, on the coast of Massachusetts, on

* *Artiocco* is an obvious misprint.

(606.) Wt. 158—829. 1,125. 10/19. J. T. & S., Ltd. G. 14. Sch. 12.

July 21st, 1605; but it does not exist in a wild state so far north, or so far east, and its country of origin remained unascertained till the year 1883.* Indeed, in Torrey & Gray's Flora of N. America, p. 332 (1843) it is spoken of as "an introduced species, said to have been derived originally from Brazil," and in the first edition of Gray's Manual of the Botany of the Northern U.S., p. 228 (1848), it is mentioned as "naturalized" with no hint of its origin. De Candolle, Geographie Botanique, ii. p. 824 (1855) says, "la plante n'a été trouvée spontanée nulle part," and hesitates between the claims of Canada, Brazil and Peru; but about that year, 1855, Asa Gray received from Dr. Short, of Kentucky, some of the long, narrow tubers of *H. doronicoides*, Lam. These† produced, after two or three years' cultivation, shorter and thicker tubers, which, when cooked, were found to resemble the Jerusalem Artichoke in flavour, although coarser. Consequently that species is wrongly assumed to be the parent of the "Jerusalem" in Gray's Manual of the Botany of the Northern U.S., p. 219 (1856), and in subsequent editions up to that of 1878, as well as in Trumbull & Gray's Notes on the History of *H. tuberosus* in Amer. Journal of Science and Arts, 3rd series, xiii. p. 347 (1877). However, in the same Journal, xxv. p. 244 (1883), these authors remark. "It can now be said that the wild species to which *Helianthus tuberosus* has been traced is not *H. doronicoides*, Lam. The aborigines who cultivated it must have obtained it from the valleys of the Ohio and Mississippi and their tributaries where it abounds." Then in his Synoptical Flora of N. America, ii. p. 280, of the following year, 1884, Asa Gray assigns to it "moist alluvial ground, Upper Canada to Saskatchewan, and south to Arkansas and middle parts of Georgia. Was cultivated by the aborigines, and the tubers developed; now widely dispersed under cultivation."‡ This conclusion is accepted and confirmed by later floras of North America. *H. tuberosus* is figured in Bot. Mag. t. 7545, where Hooker pointed out the difference from *H. doronicoides* figured at t. 2778 under the erroneous name of *H. pubescens*, Vahl.

Although Canada, not in its modern but in its early and wider sense, was well known to many botanical authors in the first half of the seventeenth century, such as Ravelingen, Parkinson, Lauremberg and others, to be the source from which the Jerusalem artichoke was introduced, yet many confused notions of a supposed origin from Brazil, the West Indies and Peru have prevailed from time to time. For instance, Martyn, in his edition of Miller's Gardener's Dictionary (1807) says, "not that Canada is their original country, for they are unquestionably the produce of a hot climate, being natives of Brazil."

When Linnaeus first speaks of the plant in Hortus Cliffortianus, p. 419 (1737) as *Helianthus radice tuberosa* he very judiciously assigns "Canada" as the habitat, but in Sp. Pl. p. 905 (1753), where he creates the name *Helianthus tuberosus*, he unfortunately

* Not 1884, as sometimes stated.

† *American Journal of Science and Arts*, xiii. l.c.

‡ This passage was supposed by Hooker, l.c. (and by Gibault) to be the first "establishment of the indigenous species."

alters this to "habitat in Brasilia," perhaps misled by the synonym *Chrysanthemum latifolium Brasilianum* of C. Bauhin, Prod. p. 70 (1620). Bauhin's description is in itself unrecognisable, and no wonder, for he says "Haec in ramo exsiccato, quem Chrysanthemi Brasiliani nomine, ex horto nobiliss. Contarini habemus, notare potui"; but when he wrote his Pinax in 1623 (p. 277) he had discovered that his *Chrysanthemum latifolium Brasilianum* was identical with Colonna's *Flos Solis Farnesianus*, sive *Aster peruvianus tuberosus*, and that it was known to some (quibusdam) as *Chrysanthemum e Canada*, to others as *Canada Artischoki sub terra*. He places it with the other sunflowers, which he associates with *Helenium vulgare* (Elecampane), and calls it, by an obvious slip of the pen or misprint, *Helianthemum Indicum tuberosum*, which looks as if "Indicum" were a compromise between *Brasilianum* and *Peruvianum*.*

Unquestionably the earliest account of *H. tuberosus* by a botanical author is that of Fabio Colonna (Columna). He does not allude to it in his Phytobasanos of 1592, or in the first edition (1606) of his Ecphrasis, which only contains the first portion of that work; but in the second edition of 1616, where the second part dedicated to Cardinal Edoardo Farnese appeared for the first time, we find at p. 11 a description of *Flos solis Farnesianus*, sive *Aster Peruanus tuberosus*, which is figured on p. 13. We must be careful to observe that this name does not prove that the author supposed the plant to come from Peru. The sunflower, *Helianthus annuus*, was already known as *Chrysanthemum Perunianum*, Dod., Flor. Hist. p. 294 (1568) or *Solis Flos Perunianus* Lobel, Stirp. Obs., p. 322 (1576), so that *Aster Peruanus tuberosus* might, after the fashion of speech of these old authors, mean simply "the tuberous sunflower," without any connotation of a Peruvian origin. In the text itself Colonna makes no statement of any kind as to the habitat of the plant, which he had seen at Rome in the splendid garden of Cardinal Farnese, of whom he says, "humanissimus ille Princeps conquisitas undique, & ab ipsis etiam Indijs advectas, clariores plantas in eo [horto] pulchre dispositas exhibere solet." To say that the Cardinal collected the finest plants from all parts, even the Indies, does not mean that the species the author is about to describe came from the West Indies. Nevertheless that he did believe it to come from the "Indies"† appears from his much later remark in his note at p. 878 of the Roman edition (1648) of Hernandez, *Rerum medicarum Novae Hispaniae Thesaurus*; "nam et Peruanum Solis florem ex Indiis tuberosum habuimus, de quo . . . verba fecimus et iconem proposuimus." His figure is remarkable, for it shows a much more floriferous plant than we are accustomed to see. This may be owing to its having

* That *Helianthemum* is a mere slip for *Helenium* is confirmed by the Index where no *Helianthemum* is quoted for p. 277 or any page near that. His other *Helianthema* are not Compositae, but Cistaceae; in fact, *Helianthema* in the modern sense.

† In the language of that time the expression might possibly include the northern United States.

been grown singly in a sunny climate* and possibly raised from seed. His was the variety with red-skinned tubers, "foris rufescens," now less esteemed by growers than the tubers with white skins.

In Aldini's account of the Farnese garden, *Exactissima descriptio rar. quorundam plant. quae continentur Romae in Horto Farnesiano* (1625),† p. 91, the culinary merits of the tubers are discussed, but nothing is added to the description in the Ecphrasis, and no light is thrown on their introduction. Not only is no Italian vernacular name quoted, but *girasole* occurs on p. 87 in the totally different sense of "*Ricinus Americanus*." To the fact that Colonna was the first botanist to speak of the Jerusalem artichoke must be attributed the false opinion that the tubers were distributed throughout Europe from the Farnese garden. Of this there is not a tittle of evidence; on the contrary, we shall find that by 1616 they were already well-known in Paris, and had probably been introduced there some nine years earlier.

"M. E." writing in the Gardeners' Chronicle of May 4th, 1918, says, "It seems certain that the Jerusalem artichoke was not introduced into Italy through France, but direct from America." I cannot understand how he arrives at such certainty. There is no record of any Italian visit to the coasts of the northern United States or New Brunswick in the early years of the seventeenth century, and, as already explained, the roots cannot have come from more southern regions of America. We have seen that Caspar Bauhin at Bale received a dried specimen, of course without tubers, from one of the Venetian Contarini not later than 1620; but that is too late to throw any light on the original source of dispersion. The critical years are 1605-1612, a time when Rome was in constant communication both with France and with the Low Countries, from either of which the cardinal may easily have received the plant without the fact being known to Colonna, who was so hopelessly wrong as to its ultimate origin.

It is now time to trace the first discovery of these tubers, and the real channel of their introduction into Europe.

Samuel Champlain, of Brouage in Saintonge (Dept. Charente Inférieure), not far from Rochelle, sailed from Honfleur on March 15th, 1603, on his first voyage to Canada, under the command of Pont Gravé of St. Malo, and disembarked on his return on September 20th of the same year. He does not appear to have noticed the Jerusalem artichoke on this occasion, for in the account of his journey, probably published early in 1604‡ under

* See below what van Ravelinghen and Lauremberg say as to the need of dry heat for it to flower freely.

† The authorship of this work is a bibliographical puzzle. It has been supposed to have really been written by Pietro Castelli. The question is too complicated to go into here, but it may be pointed out that the statements on the subject in both edition's of Pritzel's *Thesaurus* are inconsistent and inaccurate.

‡ This very rare little book is not dated, but contains a licence to print, dated 15th November, 1603. The British Museum catalogue gives the date of publication as 1603, but it seems improbable that it could have been issued before the end of that year. Ternaux, Bibliothèque Américaine, p. 36 (1837) assigns it to 1604. The year 1606 mentioned in Brunet's Nouvelles Recherches Bibliographiques i. p. 306 (1834) is obviously a slip, and is not repeated in that author's Manuel du Libraire.

the title "Des Sauvages: ou Voyage de Samuel Champlain de Brouage fait en la France Nouvelle l'an mille six cent trois," the only edible tubers mentioned are "certaines petites racines de la grosseur d'une petite nois ressemblant au goust comme treffes (*sc.* truffles) qui sont tres-bonnes roties et bouillies."* These were found on 23rd June, 1603, at Sainte Croix, some 15 leagues up the river from Quebec; but they are obviously ground-nuts, *Apios tuberosa*, Moench, which were already known from the reports of earlier voyagers to Virginia.†

Champlain sailed again from Havre—this time under the command of the Sieur de Mons‡—on April 7th, 1604, and remained in New France till August 11th, 1607, reaching St. Malo on his return on the 1st or 2nd of October in that year. He sailed for the third time on April 13th, 1608, and returned to Honfleur on October 13th, 1609. The account of these two later journeys is contained in the "Voyages du Sieur de Champlain Xaintongeois," published in 1613. On p. 83 of that work in the chapter relating the "Continuation des descouvertes de la coste des Armouchiquois" he writes: "Ce lieu est très beau . . . Nous avons nommé ce lieu le port de Mallebarre.§ Le lendemain 21 du mois (July 1605) le Sieur de Mons prit resolution d'aller voir les habitations des sauvages . . . Nous vismes des racines qu'ils cultivent, lesquelles ont un gout d'artichaut." Here the reference is unquestionably to the Jerusalem artichoke, some tubers of which he may possibly have brought back with him in 1607 or 1609, but he makes no statement to that effect.

It therefore seems that De Mons' party, of which Champlain was a member, were the first to observe these tubers; but before the above reference to them was published, they had already been mentioned in Lescarbot's "Histoire de la Nouvelle France," which appeared in 1609. Marc Lescarbot, born at Vervins, near Laon, about 1570, was a lawyer by profession, who in 1606 was induced by one of his clients, Jean de Biencourt, Seigneur de Poutrincourt,‖ to accompany him on a voyage to Port Royal, whither de Mons had transferred his headquarters from the Ile de Sainte Croix in 1605.¶ They sailed in the ship Jonas from La Rochelle on May 13th, and reached Port Royal on July 27th. De Poutrincourt, with his companions, including Lescarbot, started back with Champlain on August 11th, 1607, reaching Roscou in Brittany on September 28th, and St. Malo a few days later. Thus Lescarbot did not reach New France till just over twelve months after Champlain had observed the cultivation of *Helianthus tuberosus* by the aborigines. If the tubers were brought to France on this occasion, as seems probable, the merit

* P. 16, but in reprint of 1870, p. 27. In Purchas iv. p. 160 *nois* is mistranslated 'nut' instead of 'walnut,' and *treffes* 'mushrooms' instead of 'truffles.'

† See below.

‡ Also spelt de Monts.

§ Now Nauset harbour; 41° 50′ N.

‖ Also spelt Poitrincourt and Potrincourt.

¶ Port Royal, now Annapolis in Nova Scotia, was so called, as Lescarbot tells us, from its great beauty.

may have been Lescarbot's rather than Champlain's, for it was Lescarbot that was entrusted with the cultivation of the garden at Port Royal. He says, p. 518 "je n'ai jamais tant travaillé du corps, pour le plaisir que je tenais à dresser et cultiver mes jardins, les fermer contre la gourmandise des pourceaux . . . . semer froment, orge, avoine, fèves, pois, herbes de jardin, et les arroser."

Mr. W. F. Ganong, however, is inclined to attribute the actual importation of the tubers to another member of the same expedition, Louis Hébert, the apothecary, who was afterwards the first permanent settler at Quebec. Lescarbot mentions Hébert several times* and says of him: "Le Sieur de Monts y† fit cultiver un parc de terre pour y semer du blé & plãter la vigne, comme il fit à l'aide de notre Apoticaire M. Louis Hébert, homme qui outre l'expérience qu'il a en son art, prent grand plaisir au labourage de la terre."

Lescarbot did not return to New France, but in 1608, at the instance of his friends, wrote an account of the French expeditions up to that date, which appeared in 1609 under the title of "Histoire de la Nouvelle France,"‡ where he says, at p. 849, in describing the produce of the land, "Il y a encore en la terre des Armouchiquois§ certaine sorte de racines grosses comme le pain, très excellentes à manger, ayant un gout retirãt aux cardes, mais plus agréable, les quelles plantes multiplient en telle façon que c'est merveille." From the last remark we may gather that they had been grown in the garden at Port Royal. Whether Lescarbot ever had seen them in native kail-yards is doubtful, for he only once went beyond Port Royal, when he accompanied Chevalier to the St. John River, and appears to have reached the island of Sainte Croix, now Dochet island, in the river St. Croix, near to where it empties itself into the Bay of Passamaquoddy.‖

To continue the quotation: "je croy que ce sont Afrodilles suivant la description que Pline en fait." He means the *Asphodelus* of Pliny, Nat. Hist. xxi., c. 17,¶ a nonsensical identification.

Here again we obviously have the Jerusalem artichoke, but neither here, nor in the second edition does Lescarbot suggest that he brought the tubers to Europe. It is only in the third edition, "enrichie de plusieurs choses singulieres, outre la suite de l'histoire," and published in 1617, that he makes that claim.**

* Book iv. c. xiv. and c. xv. pp. 603 and 606 in ed. 1609; pp. 565 and 569 in ed. 1611, but pp. 557 and 561 in ed. 1618; and again in Book vi. c. xxiv. p. 841 in ed. 1609, p. 832 in ed. 1611, but c. xxiii. p. 922 in ed. 1618.

† In the Armouchiquois country, not far from Mallebarre.

‡ A second edition appeared in 1611 and was reprinted without alteration in 1612. It contains nothing additional about the edible tubers.

§ *i.e.*, Southern Maine and Massachusetts.

‖ See note in vol. iii. p. 122, of the Champlain Society's reprint of Hist. Nouv. France, and for the island of Ste. Croix, see Ganong, Dochet Island, in Trans. Roy. Soc. Canada, 2nd ser., viii. p. 127.

¶ There is no such name as Afrodillus or Aphrodillus in Pliny.

** I am informed by Mr. A. P. Biggar that the copy in the Bibliothèque Nationale at Paris, from which is taken the text reprinted by the Champlain Society (1907–1913), bears the date 1617. The British Museum copy is dated 1618.

Book V. of this edition recounts what had been accomplished in New France since his return in 1607, and at p. 660, discoursing of the special favour shown by God to the enterprises of the French, he says, "quand la necessité de vivre est venue, Dieu a fait trouver des racines, qui sont aujourd'hui les délices de plusieurs tables en France, les quelles ignorамment quelques-uns appellent à Paris, *topinambaux*, les autres plus veritablement *Canada* (car elles sont de la venues ici) et croy que ce sont les Afrodilles dont ie parleray ci-après au chapitre *De la Terre*."

Thus in 1617, the year in which, as we shall see, the tubers seem to have reached England for the first time, they were not only well known at Paris, but had already acquired the silly name of *topinambaux* or *topinambours*, by which they are known all over France to this day. Although not contemporary evidence, the following passage may be quoted from the "Histoire naturelle et morale des Iles Antilles de l'Amérique," Rotterdam, 1658, p. 100,* where the Patate, which some call Batate,† is compared to the *Topinambous* or *Artichaus d'Inde*, which, "aux superbes festins, qui se firent a Paris par les Princes, à quelques Ambassadeurs, en l'an mil six cens seize (1616), on a servi comme d'un mets precieus et exquis." The very year of Colonna's description of the plant!‡

To return to Lescarbot: in the chapter *De la Terre*, p. 931, he again describes the Jerusalem artichoke in slightly different words from those of the first edition. "Il y a encore en cette terre certaine sorte de Racines grosses comme naveaux, ou truffes, très excellentes à manger, ayant un gout retirãt aux cardes, voire plus agréable, lesquelles plantées multiplient comme par dépit, et en telle façon que c'est merveille. Je croy que ce soient Afrodilles . . . Nous avons apporté quelques unes de ces racines en France, lesquelles ont tellement multiplié, que tous les jardins en sont maintenant garnis, et les mange-on à la façon que dit Pline, ou avec beurre et un peu de vinaigre cuites en eau. Mais ie veux mal à ceux qui les font nommer Topinambaux aux crieurs de Paris."

So they were in everybody's garden at Paris whilst still a rarity at Rome, and an absolute novelty in England. Surely the plain sense of the words "nous avons apporté" is that Lescarbot and his party brought the roots with them on their return from Port Royal in the autumn of 1607, which would give them time to have become common ten years later, about the same interval as elapsed between their first arrival in England in 1617 and Parkinson's account of their abundance here in 1629.

It is not surprising that Lescarbot should not have mentioned bringing them over in his earlier edition, for their introduction

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* This book is anonymous; the preface is signed P. L. D., and its authorship is referred to Louis de Poincy. Later editions are frequently quoted as if by C. de Rochefort.

† From the accompanying plate it is evident that *Ipomaea Batatas* Poir. is meant.

‡ In John Davies of Kidwelly's translation of this work under the title of "History of the Caribby-Islands (1666) the names are given as "*Topinambous*" or "*Jerusalem Artichokes*."

was of no particular interest at first, when it could not have been foreseen that they would become so common and so popular a dish. It has recently been pointed out to me that th eexpression *nous* may not mean "I, Lescarbot, and my party," but "we Frenchmen," in which case they could hardly have arrived earlier, but may have been brought over between 1607 and 1616 by some later expedition than that which Lescarbot accompanied. This however would seem a strained interpretation of the author's words, and, although it may not be conclusively proved, there can be little doubt that the roots were imported into France on the occasion of the return of Lescarbot's party in 1607.

Lescarbot has unfortunately done his best to confuse the identity of the plant of which he meant to speak by adding, immediately after his complaint of the Parisian street-criers, "les Sauvages les appellent *Chiquebi*, & s'engendrent volontiers près les chenes." That he was wrong in his statement was long ago pointed out by Asa Gray,* who tells us that *Chiquebi* was an eastern Algonkin name for the tubers of *Apios tuberosa*, the common ground nuts, not for those of *Helianthus tuberosus*. Gray indicates the source of Lescarbot's error. In the previous year, 1616, there had appeared at Lyon† the "Relation de la Nouvelle France," by Father Pierre Biard, who arrived in Acadie on Whitsunday, 1611. Father Biard says, "ils allèrent à la queste du gland et des racines. Ces racines *sont appelés en Sauvage chiquebi, et s'engendrent volontiers auprès des chesnes*; elles sont comme truffes, mais meilleures, et croissent sous terre enfilées l'une a l'autre en forme de chapelet." Now the words in italices are practically identical, even to the phrase "s'engendrent volontiers," with those of Lescarbot, who clearly was not making an observation of his own, either as to the name *chiquebi* or as to the predilection for growing under oaks, but was simply quoting Father Biard, without noticing that the tubers mentioned by the Jesuit are not those of which he had himself been speaking.

With regard to these *Apios* tubers, found by Champlain in 1603 and described by Biard; they had long before been mentioned by Thomas Harriot in his "Briefe and true report of the new found land of Virginia,"‡ "*Openauk* are a kind of rootes of round forme, some of the bignesse of Walnuts, some farre greater, which are found in moist and marish grounds growing many together one by another in ropes, as though they were fastened with a string. Being boiled or sodden, they are very good meat. *Monardes* calleth these roots, Beads or *Pater nostri* of *St. Helena*." Then in Gosnold's "Briefe and True Relation of his

* Am. Journ. Sci., 3rd series, xxv. p. 244.

† The British Museum does not possess the original edition, so I have only seen the reprint in "Relations des Jesuites," Quebec, 1858, at p. 43. It was after the murder of Henri IV. in 1610 that the Jesuits actually obtained entrance to New France, to the apparent annoyance of Lescarbot, who distrusted father Biard.

‡ The name is also spelt Harriott and Heriot. The original edition of 1588 is not paged, but this passage will be found at C 4, or at p. 32 in the privately printed facsimile of 1900.

Voyage to Virginia," p. 7 (1602), " in every island and every part of every island are great store of ground-nuts, fortie together on a string, some of them as bigges as Hennes egges," and Denys, " Descr. Geogr. et hist. des Costes de l'Amerique septentrionale," II., p. 350 (1672) describing the ground-nuts says, " elles s'appellent des *Chicamins*," which is apparently a variant of Père Biard's *Chiquebi*. The Monardes referred to was a Spanish physician (1493-1588) author of the Historia medicinal de las cosas que se traen de nuestras Indias occidentales, que sirven en medicina (1569). His work naturally contains no reference to *Helianthus tuberosus*, but in Colin's French translation with additions, published in 1619, as Histoire des simples médicamens apportés de l'Amerique desquels on se sert en la médecine, we read at p. 198: " Depuis quelques années en ça nous avons recouvert une plante qui, à bon droit, doit être mise au rang des herbes du Soleil; le vulgaire l'appelle Truffe du Canada; on dit qu'elle a été apportée de là . . . . Cette plante provigne de telle sorte qu'on s'en sert au lieu de glands et chastaignes, pour engraisser le bétail et les pourceaux. Nous l'appelerons doncques *Herba solis tuberosa radice, et flore prolifera.*" Here we have the first importation clearly claimed for the French in the words " nous avons recouvert," and the use of the tubers for fattening cattle and pigs implies that they must have been in cultivation for a certain number of years, which would be quite in accord with their having come over with Lescarbot in 1607.

The supposed first introduction of *Helianthus tuberosus* by Cardinal Farnese having been rejected in favour of the French, it remains to consider whether any claim can be made on behalf of the Low Countries. The first to grow them there was Petrus Hondius, known from the mention of him by van Ravelinghen and by Lauremberg, referred to below, as a mighty gardener who lived in Zeeland at Terneuzen (otherwise Neuzen) near the mouth of the Lys canal on the southern shore of the Hond, or western branch of the estuary of the Scheldt. His latinised name is obviously taken from that of the estuary.

Dodoens, who died in 1585, and Lobel, whose latest publication is of 1605, though he lived till 1616, know nothing of the Jerusalem Artichoke. Nor does Gaspard Pelletier of Montpellier in his very rare* " Plantarum tum patriarum tum exoticarum in Walachria,† Zeelandiae insula nascentium synonyma," published at Middelburg in 1610, make any allusion to it. But Joost van Ravelinghen's 1618 edition of Dodoens' Cruydt-Boeck contains an appendix‡ of exotic plants not mentioned by Dodoens. There at pp. 1475, 1476, is a long account of *Helianthus tuberosus* under the name of *Batatas van Canada* or *Articiocken onder d'aerde*

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* The only copy I can trace in England is at Kew.

† *i.e.*, Walcheren.

‡ "*Beschrijvinghe van de Indiaensche oft Wtlandtsche Boomen, Heesteren ende Cruyden . . . . die van Dodonaeus niet vermaent oft niet beschreven en zijn ghewest.*" This appendix with identical paging is also included in Moretus' edition of 1644. As the old Dutch is rather crabbed the quotations below are in English, for which I have to thank the Rev. George Edmundson.

(underground artichokes). We thence learn amongst other matters: (1) that Petrus Hondius was the first to describe the plant fully: (2) that the tubers had been planted, apparently by Petrus Hondius, at least as early as February, 1613; (3) that van Ravelinghen knew them to come from Canada; (4) that he was acquainted with the mention of them in Lescarbot's Histoire de la Nouvelle France. The most important passages run: "The young tubers are of various form, to wit, some round, some oval, some flat, some oblong like pears . . . . and with such fecundity that their multiplication in propagation is so great as to cause astonishment to the very learned Petrus Hondius, who was the first to give a full description of this plant." . . . "One of the tubers, half-withered and without sap, not larger than a small chestnut, stuck in the ground on the 28th of February, 1613, had on the 13th November of the same year eleven roots, the smallest of which was twice as large as the mother." . . . , . "This plant was first brought to this country from the French Indies that are called Canada, although it does not multiply its roots there so much as here, nevertheless here it does not bloom, except when the summers are hot and there is a long drought. The right name of this plant is unknown to us, but Petrus Hondius calls it Artichoke under the ground, in Latin *Chrysanthemum Canadense tuberosum edule*. Others call it *Batatas Canadense*, that is Batatas of Canada; others *Flos Solis Canadensis*, or *Herba solis tuberosa radice*, that is Sunflower with tuberous roots from Canada; others *Helenium Canadense*, or *Solis herba Canadensis*; others *Heliotropium Indicum tuberosum*; in our speech Artichoke-apples of Ter-Neusen, or Knobs, Tubers or Hundred-heads, because the describer of New France held the same for *Asphodelus Plinii*. The inhabitants of Canada eat these roots as a dainty though common dish." Thus we have an earlier date for their cultivation in the Low Countries than that of Colonna's mention of them in the Farnese gardens.

The next allusion is in Lauremberg's "Apparatus Plantarum primus," published at Frankfort-on-the-Main in 1632. Attention was called to the passage, which at first sight seems all important, by Schlechtendal in Bot. Zeit. xvi., p. 113 (1858), but as van Ravelinghen's account had escaped his notice, he wrongly supposes Lauremberg to be the only author who mentions Petrus Hondius. Lauremberg says, p. 131, "*Adenes Canadenses, seu Flos solis glandulosus* appellamus plantam novam, a paterno solo, Canada, quae est Americae provincia, unde primum ante annos triginta, aut circiter, in Bataviam transvecta fuit." Then he enumerates the same set of synonyms that we have already found in Ravelinghen and proceeds, "*Artischokappeln van ter Neusen*: quia Petrus Hondius in praedio suo ter Neusen primus has glandes, tum ex America advenas excepit; tum in hortis suis educavit: tum a se transmissas ad amicos, communes reddidit toti Germaniae, imo Europae." Now, if this statement were reliable, and the tubers had really been brought from Canada to Holland thirty years before 1632, *i.e.*, in 1602, that would certainly be their earliest introduction, and it would take the wind out of the sails of the French as well as of Cardinal Farnese;

but from the following considerations it will be evident that Lauremberg was speaking vaguely, from memory, and that the date, 1602, is much too early, and moreover that if he meant to say that the Dutch had brought them direct from Canada he was wrong.

1. There were no Dutch expeditions during the critical years 1600-1612 to the districts where the aborigines were found by the French voyagers to cultivate these tubers.

2. Pelletier could hardly have omitted to mention them in 1610 in his list of the plants of Walcheren, just across the Hond from Terneuzen, if they had arrived there so early as 1602.

3. Peter Lauremberg (1585-1639) was born and died at Rostock, where, as well as at Hamburg, he held the chair of botany. His opportunities cannot have been so great as those of van Ravelinghen, a Dutchman, for close and contemporary knowledge of Petrus Hondius.

4. He is vague about the "thirty years," for he adds "or thereabouts."

5. His language reads like an echo of what he ought to have read in van Ravelinghen's Dodonaeus; for instance in the passage "Nam plurimae aestates etiam in Belgio* labuntur cum nullo flore his flos solis conspicuus est. Ubi aestas acriter fervet et sicca est admodum . . . planta solet florifera fieri" as well as in the passage already quoted. Nevertheless he alleges on p. 134 "a nemine enim depictam aut descriptam hactenus vidi." If indeed he had never read van Ravelinghen's account, the verbal coincidences are surprising.

6. If his date were correct, it could hardly have been unknown to van Ravelinghen, who obviously was in correspondence with Petrus Hondius, and would hardly, in that case, have spoken of the planting in 1613 as if the tubers were then a novelty.

7. If they had been grown in Holland earlier, in fact much earlier, than in France it is not likely that their first arrival in England would have been, as we shall shortly see, through a Frenchman.

We may thus dismiss Lauremberg's claim that Petrus Hondius was the first to introduce Jerusalem artichokes to Europe, though he may have been the channel of their transmission to Germany, and very possibly to Italy as well.

Let us now turn to England. The Jerusalem artichoke was not known to Gerarde, who does not allude to it in his Herball of 1597. The earliest published reference is in the second edition (1622)† of Venner's Via recta ad vitam longam, p. 134, in a quaint passage: "Artichoks of *Jerusalem* is a roote usually eaten with butter, vinegar, and pepper, by itselfe, or together with other meates: It is in nature somewhat answerable to the former (*i.e.*, Artichoks), but not so pleasant in taste, nor of so commendable nourishment. It breedeth melancholy, and is somewhat nauseous or fulsome to the stomacke, and therefore very hurtful

* The southern shore of the Hond was "in Belgio," although not comprised in the modern kingdom of Belgium.

† In the Oxford English Dictionary the passage is referred to the first edition of 1620, where it does not occur.

to the melancholick, and them that have weak stomackes." But in the previous year John Goodyer* had written an account of it in a letter to Thomas Johnson, dated October 21st, 1621, and printed in Johnson's Gerade, pp. 753, 754 (1633).†

Johnson tells us that Goodyer "as you may see by the date" of the letter, "tooke it presently upon the first arrival into England." Goodyer's words are: "Where this plant groweth naturally I know not. In *An.* 1617 I received two small roots thereof from Mr. Franquevill of London, no bigger than hens eggs, the one I planted, and the other I gave to a friend: myne brought me a pecke of roots, wherewith I stored Hampshire." From his obviously French name we may surmise that Mr. Franquevill had received his tubers from France. He must have been either the elder or the younger John de Franqueville, mentioned by Parkinson in his *Paradisus* of 1629.‡ The elder first brought to England the daffodils that Parkinson calls *Narcissus narbonensis medio luteus* from his own country of Cambray, "from whose son now living we have all had it."§ We also learn from Parkinson, p. 134, that either father or son was a correspondant of Vespasian Robin, who, with his father Jean Robin, was "king's botanist" at Paris. The French connection thus established, and especially

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* John Goodyer, born at Alton, Hants, in 1592, of yeoman ancestry, subsequently lived in the parish of Buriton at the foot of the South Downs in the same county, but after his marriage in 1632 removed to the neighbouring town of Petersfield, where he died in 1664. He discovered many rare plants in Hampshire and is frequently quoted by Johnson. Both Johnson and Parkinson (Paradisus, p. 248) refer to him as "of Maple Durham." The extensive Domesday manor of Malpedresham, a name which after various strange vicissitudes of spelling, became Mapledurham, included Petersfield as well as Buriton; but in consequence of a forfeiture the manor of Petersfield was separated from that of Mapledurham in 1484. Subsequently Mapledurham itself was divided into two manors, one of which, East Maple, or East Mapledurham, after belonging to the Hanburys, was owned by three generations of Gibbons, by the last of whom, Edward Gibbon, the historian, it was sold and is now Bonham-Carter property. West Mapledurham was owned by the Shelleys in Goodyer's time. It possessed a fine old manor house, pulled down in 1829, in which it has been suggested that Goodyer resided, but this supposition rests on no evidence beyond Johnson's and Parkinson's phrase "of Mapledurham." In his will, dated April 22nd, 1664, Goodyer describes himself as "of Weston in the parish of Buriton," and devises his "messuage in Weston and lands there upon trust for the placing forth of poor children of the tithing of Weston." which is comprised in the parish of Buriton and manor of West Mapledurham. See the articles on John Goodyer by Canon John Vaughan in the "Cornhill" Magazine for June, 1909; by Mr. G. C. Druce in the Botanical Society and Exchange Club Report for 1916, p. 523; and by Miss Mabel E. Wotton in the *Hants and Sussex News* of April 11th, 1917; also the Journal of Botany for 1916, p. 375, and for 1917, p. 167. None of these otherwise admirable notices give a satisfactory account of Goodyer's connection with Mapledurham, which of course has nothing to do with the Mapledurham on the Thames or with Maplederwell near Basingstoke.

† The later edition of 1636 is a mere reprint, embodying some of the *errata corrig.* of that of 1633.

‡ pp. 86, 88, 102, 134, 420, 434.

§ The records of the Huguenot Society of London refer to a Jean Franckvilla in 1605, and in 1634 and 1641 there are entries in the Register of Canterbury relating to a Jean Franckvilla stated to have come from Bailleul, which is less than 50 miles from Cambrai.

the correspondance with Robin, leave little doubt that the Franquevill tubers given to Goodyer in 1617 came from Paris. They may have been sent to him as received from France, or they may have already been grown by Franquevill in England, in which case their real first arrival in this country must be at least as early as 1616.

This date of 1616 or 1617 is quite compatible with an introduction into France in 1607, and into Holland in 1613, or shortly before; but it is surprisingly late if they had reached Holland in 1602! Goodyer calls the plant *Flos solis Pyramidalis, parvo flore, tuberosa radice, Heliotropium indicum quorundam*, and does not allude to the popular name of Jerusalem Artichoke.

Parkinson in his Paradisus (1629), p. 516, in the chapter on "*Pappas sive Batatas*; Potatoes," describes and figures *Helianthus tuberosus* under the name of *Battatas de Canada*, Potatoes of Canada, or Artichokes of Jerusalem, and declares that "they may most fitly be called Potatoes of Canada, because their rootes are in forme, colour and taste, like unto the Potatos of Virginia, but greater and the French brought them first from Canada into these parts." Now if authority is to be set against authority, Parkinson's statement should carry rather more weight than Lauremberg's as it is a few years earlier. He goes on to remark: "the potatoes of Canada are, by reason of their great increasing, grown to be so common with us in London, that even the most vulgar begin to despise them, whereas when they were first received among us they were dainties for a Queene." Yet Parkinson falls into an error in each of his three quotations from earlier authors. He states: (1) Bauhinus upon Matthiolus calleth it *Solanum tuberosum esculentum*; (2) Pelleterius of Middleborough in his *Plantarum Synonimia, Heliotropium Indicum tuberosum;* (3) Fabius Columna in the second part of his Phytobasanos, *Flos Solis Farnesianus* sive *Aster Peruanus tuberosus*. He must have been relying on his treacherous memory, for (1) C. Bauhin in Mattioli, Comm. in Diosc. p. 757 (1598) certainly has a *Solanum tuberosum esculentum*. But it is the Potato, as is clear both from his text and his figure. (2) In Pelletier's Plantarum Synonymia there is, as already stated, no such name as *Heliotropium Indicum tuberosum*,* nor is the Jerusalem artichoke there alluded to by any other name. (3) "The second part of Columna's Phytobasanos" is an error for "The second part of Columna's Ecphrasis."

Johnson, loc. cit. copies Parkinson's mistake about Pelletier, but correctly states that "Bauhinus in his Prodromus sets it forth by the name of *Chrusanthemum latifolium Brasilianum*, but in his Pinax he hath it by the name of *Helianthemum Indicum tuberosum*" and in referring to Fabius Columna he avoids naming any particular book of that author. It would, therefore be unfair to Johnson to say that he merely copies Parkinson. Probably he had no opportunity of seeing a copy of Pelletier's rare book. Parkinson has no more to say on the

* I have not been able to trace this name to any earlier author than van Ravelinghen (1618) and Colin (1619). Perhaps it was a name given by Petrus Hondius, no work of whose has come down to us.

subject in his Theatrum Botanicum of 1640, for, as he remarks on p. 1382, "there are divers sorte of rootes that are called Potatoes with us . . . . whereof all that are truly known to us are expressed in my former booke."

The Popular Names for Helianthus Tuberosus.

In France the Jerusalem Artichoke is universally known as *Topinambour*, a silly name which attached itself to the tubers very soon after their introduction, for Lescarbot tells us that in 1617 they were cried by that name in the streets of Paris, to his annoyance. The worst of this odd name is that it indicated and tended to perpetuate the false supposition that the plant is a native of Brazil, for it is the gallicised appellation of a Brazilian tribe who were a source of interest and amusement to the Parisians of the time. Jean de Léry, in his Histoire d'un Voyage fait en la Terre du Brésil, autrement dite Amérique (1578) says, at p. 58, "Sur le rivage (au Cap de Frie) nous trouvames grand nombre de Sauvages nommés Toüpinambaoults, alliez et confederez de notre nation." Then in 1613 the Sieur de Razilly on his return from the island of Maragnon,* brought with him six of these Topinamboux, and on April 15th of that year exhibited them to the Queen.† After two months three of them were dead, but the others were baptized, King Louis XIII., himself only twelve years old, standing sponsor, and then married to the French wives who had been selected for them.‡ According to Littré, *Topinambours blancs* is a name given at Hayti and at the Cape of Good Hope to the roots of *Alstroemeria* (*Bomarea*) *edulis*. Topinambour italianised into Topinambur and corrupted into such forms as Topinabò, Tupinabò, Tapinabò and even Patinabò and Tapine§ is the usual market name for the tubers in Italy, where however they are not in very common use, and are rarely cultivated in the south, although in some localities on clay soil beyond Naples they had become naturalised in the hedges 80 years ago.‖

The vulgar English name, Jerusalem Artichoke, first occurs, without comment, in the passage already quoted from Venner's Via Recta (1622). In 1629 Parkinson laughs at the name, complaining that "we in England, from some ignorant and idle head, have called them Artichokes of *Jerusalem*, only because the root, being boyled, is in taste like the bottom of an Artichoke head; but they may most fitly be called Potatos of Canada." In 1633 Johnson in his edition of Gerarde's Herball, p. 752, says, "one may well by the English name of this plant perceive that those that vulgarly impose names upon plants, have either little judgment or knowledge of them; for this plant hath no similitude

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* Maranhao, close to the north coast of Brazil, about $2\frac{1}{2}°$ S. by 44° W.

† The Queen Mother, Mary dei Medici.

‡ See Malherbe, *Lettres*, ed. Lalaume, III. p. 297, and the *Mercure de France* for 1613, p. 175, quoted in Lalaune's note to p. 314.

§ All these are given by Colla, Index nominum vernaculorum in vol. viii. of his Herbarium Pedemontanum (1837).

‖ See Tenore, Flora Napolitana III. p. 156, and Sylloge, p. 541.

. . . . with an Artichoke, but only a little likeness of taste in the dressed root; neither came it from Jerusalem, or out of Asia, but out of America." So within four years of its first arrival in England it was already called Jerusalem artichoke, and in twelve years' time that name was prevalent. Yet neither of these authors suggests any explanation of the name Jerusalem, nor do any of their successors, until Sir J. E. Smith, in 1807, put forward the theory that it is a corruption of the Italian *Girasole*, which is now the common name in Italy, both as a popular and as a book-term, for the sunflower *Helianthus annuus*. Smith refers to no authority, but merely says in his Introduction to Botany (1807) p. 108, note: "a corruption, I presume, of the Italian name *Girasole Articiocco*, as the plant was first brought from Peru to Italy, and thence propagated throughout Europe." The same statement—apparently a mere guess bolstered up by the false story of the first importation—was repeated by him in Rees' Cyclopaedia vol. xviii. (1819). Smith's great authority spread this theory far and wide. It has been uncritically accepted by Phillips, History of Cultivated Vegetables (1822) I., p. 294, by W. B. Booth in Lindley & Moore's Treasury of Botany (1866) p. 575,* and even by such weighty and careful authors as Alphonse de Candolle, Geog. Bot. ii., p. 824, note (1855), Trumbull and Gray in Am. Journ. Sci., 3rd series, xiii. p. 352 (1877), and Hooker in Bot. Mag. liii., 7545 (1897).†

Outside the ranks of botanists we find Thomas Love Peacock writing in 1861‡ "We have an excellent old vegetable, the artichoke, of which we eat the head; we have another of subsequent introduction, of which we eat the root, and which we also call artichoke. . . . This last is a species of helianthus or sunflower. . . . It is therefore a girasol, or turn-to-the-sun. From this girasol we have made Jerusalem, and from the Jerusalem artichoke we make Palestine soup."

That there is nothing shocking to scientific philology in such a derivation is apparent from Max Müller's Lectures on the Science of Language, 2nd series, p. 368 (1868); "There is a soup called Palestine soup. It is made, I believe, of artichokes called Jerusalem artichoke,§ but the Jerusalem artichoke is so called from a mere misunderstanding. The artichoke, being a kind of sunflower, was called in Italian *girasole*, from the Latin *gyrus*, and *sol*, sun. Hence Jerusalem artichokes and Palestine soups."

Here the matter rested until the sceptical mind of a prince of gardeners led him to express doubt in the Gardeners' Chronicle for March 30th, 1918, p. 140. "Speaking for myself," writes Mr. Vicary Gibbs, "I disbelieve profoundly in this derivation. I doubt if any evidence can be produced that the Italians have ever called this vegetable 'Girasole.'" Since reading this startling remark the present writer has made every effort, but in vain,

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* Quoted and apparently relied on in the Oxford English Dictionary, sub voce Artichoke 2.

† Hooker's article contains some bibliographical inaccuracies.

‡ Gryll Grange, p. 1.

§ Max Müller's botany is less trustworthy than his philology.

to find some evidence that the Italians called either the plant, or its tubers, *Girasole*, at or before the date when the name Jerusalem Artichoke came into use in England. No less than that will support the etymology. Even if it be established that the name *Girasole* has occasionally been extended in the semi-scientific language of modern Italian botanical authors to cover *Helianthus tuberosus* as well as *Helianthus annuus*, it will not account for "Jerusalem" at a date when there is no trace of *girasole* having been used by the Italians (as it came to be later) for the annual sunflower, much less for the tuberous species.

The earliest use of the word *girasole* seems to have been in a mineralogical sense for the fire-opal, and it seems to have first been employed botanically not for a sunflower, but for *Ricinus communis*, the Castor oil plant! Such is its meaning in Mattioli's Commentaries on Dioscorides, of which many editions appeared, some in Italian, some in Latin, from 1544 to 1604.

Cesalpini, De plantis libri xvi. p. 380 (1583), says "*Ricinus* vulgo *Girasole*," and in Florio's quaintly named Italian-English vocabularies, Giardino di Ricreatione (1591), A worlde of words (1598), Queen Anne's New worlde of words (1611), and in his Vocabolario Italiano e Inglese, ed. Torriano (1659), *girasole* is said to mean "an herbe called in Latin Ricinus or Croton; also as Heliotropia; also changeable taffeties; some take it for fine-leaved grass." Above all, Allacci in his account of the Farnese garden, already referred to, at page 87, says of *Ricinus Americanus* "aliqui dixere girasole." In fact it is not till the Phytologia of Ambrosini (1666) p. 287, that *girasole* is found to mean *Helianthus annuus* in Italian. How then is it possible for it to have been in general use for *H. tuberosus* at such a date as to have begotten the English "Jerusalem artichoke" by 1622?

Allacci's remark is alone quite fatal to the theory that plant and *name* were introduced from the Farnese garden.

In the Vocabolario della Crusca (1738) the tubers of *Helianthus tuberosus* are called *tartufi bianchi*, white truffles;* "Tartufi bianchi diciamo ad alcune Radiche simili a quelle delle canne, che si mangiano in diverse maniere in tempo d'inverno, e si cavano da una pianta detta dal Lat. *Aster Peruanus tuberosa radice*." It is not till Targioni-Tozzetti's Dizionario botanico italiano (1809) ii. p. 52, that we find *Girasole del Canada* among the Italian equivalents of *H. tuberosus*, the others being *Patata americana*, *Patata del Canada*, *Tartufo bianco*, *Tartufo di Canna*, *Topinambour*. Yet in the various editions of the same author's Istituzioni botaniche, of 1796 (ii. p. 192), 1802 (iii. p. 238) and 1813 (iii. p. 202), *Girasole del Canada* does not occur among the sundry vernacular names. No doubt it has been inserted in the Dizionario as a quasi-learned book-name, without having ever been employed in current usage. It reappears later in Camisola's Flora Astese (1854) p. 245, and again in Tommaseo e Bellini, Diz. della Lingua Italiana, although the chief Italian floras do not include it among their synonyms for *H. tuberosus*. Prof. Mattirolo of Turin tells me that he has heard his students speak

* Not the famous *tartufi bianchi* of Piedmont, which are true truffles, *Tuber Magnatum* Vittad., as to which see Colla, Herb. Ped. vii. p. 212 (1837).

of this *Helianthus* as *Girasole* and *Girasole del Canadà*. Nevertheless although *Girasole del Canadà* may be occasionally used by students of botany in a pseudo-scientific way, it is certainly not the usual and popular term, which according to the evidence of correspondents, botanical and simple, at Florence, Rome and Naples, is now-a-days *topinambur* or *topinabò*.

In any case the name *Girasole del Canada* could not have come to us from Italy at the time when Colonna seems to have thought that the plant was a native of tropical America.

Smith's theory, at first sight, seems to require not only the use of *girasole*, but its use in the special combination which he claims of *girasole articiocco*. Yet in reality this particular combination is not necessary to account for "Jerusalem artichoke" on the Italian hypothesis. It would be sufficient if we could prove the use of *girasole* alone at the proper date, for the "artichoke" would easily have been added to the "Jerusalem" by our own growers. Nevertheless the supposed *girasole articiocco* calls for some criticism: (1) this combination is not found in any Italian dictionary or botanical work; (2) it has never been heard by any of the Italians of whom I have made inquiry; (3) it is in itself extremely improbable, owing to the familiarity of all Italians, of every class, with the true artichoke, which would make them much less likely than the English or the Dutch to associate with it a *Helianthus*; (4) the word *articiocco* is unknown in any part of Italy south of the Apennines, where *carciofo* is the universal name for *Cynara Cardunculus*, *articiocco* and such allied forms as *arcicioffo, archiciocco, artichiocch*, etc., being confined to the dialects of northern Italy. Consequently such a name could not have come to us from Rome, whence these tubers were supposed to have been introduced.

These north Italian names are of some philological interest, and like our own *artichoke* and the French *artichaut* were considered by Prince L. L. Bonaparte to have an entirely different origin from that of *carciofo*. In a paper on the Neo-Latin names for artichoke in the Academy for March 15th, 1884, reprinted in Transactions of the Philological Society (1885) as App. iii., he maintained that whilst the Italian *carciofo* comes from the Arabic *harshaf*, and the Spanish *alcachofa* from *harshaf* preceded by the article *al*, such forms as *articiocco*, *artichaut* and *artichoke* derive through a Low-Latin *articoccus* or *articactus*, by the addition of the prefix *arti*, from Pliny's cactus and Theophrastus' κακτός, the name used by these ancients for the artichoke or cardoon.*

To conclude: i. There never has existed such an Italian combination as the *girasole articiocco* assumed by Smith as the origin of our *Jerusalem artichoke*.

ii. In the absence of any evidence that *girasole* was used for any species of *Helianthus* till long after the name *Jerusalem artichoke* had been adopted in England, it is difficult to see how the suggested etymology can be defended.

iii. Nevertheless, whilst the misapplication of the name *artichoke* to a *Helianthus* is indigenous in England, and certainly did not come from Italy, it is not certain that our *Jerusalem* in

* Prince L. L. Bonaparte's view is not accepted by all philologists.

this connection may not be a corruption of *girasole*, though not necessarily of the Italian *girasole*.* Indeed it looks as if the transference of *girasole* from the fire-opal and the *Ricinus* to the sunflower may have taken place in England earlier than in Italy, for in Sidney's Arcadia (1586) there is a fanciful personification in the lines

> "With gazing eyes he lookes, short sighs, unsettled feet,
> He stood, but turned as *Girasol* to sun."†

Now if Sidney here meant to personify the sunflower, as is assumed by the Oxford English Dictionary sub voce Girasole, the word might easily have been applied by some scholar-gardener under Euphuist influences to the tuberous *Helianthus* when it made its appearance here, and any unlettered gardener who heard the name would most easily repeat the ill-caught sound as Jerusalem. This is of course a mere speculation, but it is the only suggestion I can put forward to account for an etymology that I am loth to abandon finally though it must certainly be rejected in the form in which it was proposed by Sir J. E. Smith.

The tubers of *Helianthus tuberosus* known to the early authors —Colonna, Ravelinghen, Goodyer, Parkinson—were of a red or reddish-brown colour outside, and Prof. N. L. Britton writes from the New York botanical garden on December 21st, 1918: "so far as my knowledge extends the wild plant has only red tubers." In 1889 the late Mr. Barron, Secretary to the Royal Horticultural Society, in his report on the vegetable conference of that year, called attention to the fact that only one variety was grown; but soon afterwards the white-skinned variety, which is now the favourite, was introduced by Messrs. Sutton. In their catalogue (Amateur's Guide in Horticulture) for 1891, p. 47, they say: "We are glad to be able to offer a great novelty, the tubers of which were discovered by a botanist in South America, and have been grown in this country for the past five years." Mr. Arthur Sutton has kindly informed me that this "white artichoke" introduced by his firm in 1891, was purchased from Mr. P. H. Pierce, of St. Dunstan's nursery at Canterbury, on December 24th, 1889, for the sum of £7, and was supposed to have been collected by a botanical friend of Mr. Pierce in South America. But the South American origin is hardly credible, and Mr. Walter R. Pierce, of St. Dunstan's, on being referred to, does not adhere to it. He writes to Messrs. Sutton on January 11th, 1919, "I raised the white Jerusalem Artichoke from a tuberous-rooted *Helianthus*, which a friend of mine (Dr. Brodie) imported from abroad. It may have come from South America with a lot of other specimens he received, but I believe it came from Holland." For the present therefore the origin of this white kind remains obscure. Another form known as the Rose Artichoke in growers' lists was introduced into England in

* Against the probability of the corruption of the Italian word into Jerusalem, it may be pointed out that in Italian *girasóle* has two accented syllables, both long in quantity, neither of which is the syllable on which the stress falls in our Jerúsalem.

† p. 91 in the edition of 1598.

1914, also by Messrs. Sutton, who obtained it from MM. Vilmorin, Andrieux & Co., of Paris.

Since the above was written there has appeared in the American Naturalist for March, 1919 (vol. liii.), a paper by Prof. Cockerell on the Varieties of *Helianthus tuberosus*, in which he enumerates and names six forms, all except the first having been grown by him in Boulder, Colorado.

These are: (a) *typicus*, the plant figured by Colonna, as to which Prof. Cockerell remarks "I have never seen a plant with exactly this combination of characters."

(b) *nebrascensis*, a wild form from Nebraska, also very floriferous, and with a pale brown skin.

(c) *Alexandri*, wild in Michigan; tubers white, with a very thin brownish skin.

(d) *purpurellus*, sent out by the firm of Childs as "Pink Helianthi," but without information as to its origin. Colour deep pinkish-purple, as in var. *purpureus*.

(e) *fusiformis*, the "Rose" variety of Messrs. Sutton.

(f) *albus*, of which the author says "We first got this, a number of years ago, from Dreer of Philadelphia. Mr. L. Sutton tells me that his firm first offered it in 1915, having obtained it from someone who said it had been sent him by a friend in South America. He believes it had not been grown in England before this. Dreer had it much earlier in this country, having obtained it from Mr. A. E. Coleman of Enonville, Va. Mr. Coleman states that he knows nothing of the origin of the variety."

It will be noticed that 1915 (possibly a misprint) is twenty-four years later than the true date of appearance of this variety in Sutton's lists. Unfortunately this mistake and the lack of a definite date for Mr. Coleman's acquaintance with *albus*, leave the relative priority of its introduction in England and in the U.S.A. undecided.

If Coleman had the plant earlier than 1889 it is probable that Pierce, who sold his stock to Suttons, must really have received the tubers from the United States.

(g) *purpureus*, received from Suttons as the variety long cultivated in England.

Of these forms (a) and (b) are much branched, floriferous forms; the rest are tall, less branched and more leafy, as they are known to us in cultivation. Other distinctive characters are pointed out in Prof. Cockerell's paper.

XXV.—"DIOSCOREA SATIVA."

D. Prain and I. H. Burkill.

Considerable difficulty has from time to time been experienced by systematic students in deciding what should be the precise incidence of the name *Dioscorea sativa*, first proposed by Linnaeus in 1753 (*Sp. Pl.* ed. 1, p. 1033). The writers, in the course of a revision of the Asiatic species of the genus on which they have been engaged for a number of years, have had occasion to review the position adopted by previous students of the genus with the

object of arriving at a definite conclusion. The nature of the conclusion to which they have been led is such as to render it desirable to explain how the difficulty experienced by their predecessors has arisen, and to give a brief historical review of the various attempts that have been made to solve it, as preliminaries to the statement of the results at which they have themselves arrived.

Though Linnaeus first applied specific names to components of the genus *Dioscorea* in 1753 he had already formed conceptions of the limitation of five out of the eight species then named as early as 1737 (*Hort. Cliff.* p. 459), and of two of the remaining three in 1747 (*Flor. Zeyl.* pp. 170-2). The terms in which these conceptions were expressed in 1753 are as follows; the dates of their respective formation are added in each case:—

pentaphylla. 1. Dioscorea foliis digitatis. Four references are given to assist in the interpretation of this conception; there is no specimen to illustrate it in the proper herbarium of Linnaeus: *Hort. Cliff.* (1737) n. 5.

triphylla. 2. Dioscorea foliis ternatis. Two references given; no specimen: *Hort. Cliff.* (1737) n. 4.

aculeata. 3. Dioscorea foliis cordatis, caule aculeato bulbifero. Four references; no specimen: *Hort. Cliff.* (1737) n. 3.

alata. 4. Dioscorea foliis cordatis, caule alato bulbifero. Five references; one specimen: *Flor. Zeyl.* (1747) n. 360.

bulbifera. 5. Dioscorea foliis cordatis, caule laevi bulbifera. Five references; one specimen: *Hort. Cliff.* (1737) n. 2.

sativa. 6. Dioscorea foliis cordatis alternis, caule laevi. Seven references; one specimen written up by Linnaeus, with another attached but not written up: *Hort. Cliff.* (1737) n. 1.

villosa. 7. Dioscorea foliis cordatis alternis oppositisque, caule laevi. Two references; no specimen: *Sp. Pl.* (1753).

oppositifolia. 8. Dioscorea foliis oppositis ovatis acuminatis. Two references; no specimen: *Flor. Zeyl.* (1747) n. 361.

It may assist us in appreciating the situation if the diagnostic characters stated and implied by Linnaeus in this arrangement be presented in the form of a key, implied characters being placed within brackets.

Key to the Linnean species of Dioscorea.

Leaves digitate:—	
[Leaflets more than three]	1. *D. pentaphylla.*
Leaflets three only	2. *D. triphylla.*
[Leaves simple]:—	
Leaves cordate:—	
Leaves with axillary bulbils:—	
Stem armed with prickles	3. *D. aculeata.*
[Stem unarmed]:—	
Stem winged	4. *D. alata.*
Stem not winged	5. *D. bulbifera.*

[Leaves without axillary bulbils]; stem unarmed:—	
Leaves all alternate	6. *D. sativa.*
Leaves some alternate, some opposite	7. *D. villosa.*
Leaves ovate, all opposite	8. *D. oppositifolia.*

The main defect in this system, it will be seen, lies in the distinction relied upon in discriminating between *D. sativa* as delimited in 1737 and *D. villosa*, newly intercalated in the system in 1753, since specimens of the latter collected from such portions of the plant as may be unprovided with opposite leaves must of necessity be attributed to the former. Another defect, which in the existing state of botanical knowledge it was impossible to appreciate in 1753, results from the fact that species beset with prickles may produce shoots that, especially towards their extremities, are unarmed, and that species which produce bulbils in the same way may develop shoots, the leaves on which are not bulbilliferous, so that particular specimens derived from a plant that according to the above key are really referable to *D. aculeata* or to *D. bulbifera* may, in the absence of a knowledge of the whole individual to which they belonged, be placed of necessity under *D. sativa*. We shall find indications as we proceed that Linnaeus himself, and others who have relied, perhaps too implicitly, on his authority, have been led to interpret too widely the specific limits of *D. sativa*. On the other hand we shall find that those who have been led to realise the difficulty now explained have not always been in accord as to which of the incongruous elements that accord with the Linnean definition should enjoy the distinction of bearing the designation *D. sativa*.

It is not necessary for the purpose of our enquiry to deal exhaustively here with the various references and citations under the other seven segregates proposed by Linnaeus in 1753. It is, however, desirable to understand exactly what the plants are which he treated as belonging to *D. sativa*. In 1737 (*Hort. Cliff.* p. 459) Linnaeus cited as the male of his species *Ricophora indica* s. *Inhame malabarica, folio rotundo in acuminatissimum apicem mucronato* (*Pluk. Alm.* p. 321) and *Mukelengu* (*Rheed. Hort. Malab.* vol viii. p. 97. t. 51). A reference to Plukenet shows that the descriptive phrase quoted was taken up by Plukenet from Hermann (*Par. Bat. Prodr.* p. 371) and a reference to Hermann shows that the phrase was coined by him to indicate the *Mu-kelengu* of Rheede. These two references to the male of *D. satira* therefore both relate to the same Old World plant. Under the female of the same species Linnaeus cited three plants, all from the Western Hemisphere; 1. *Dioscorea scandens, foliis tamni, fructu racemoso* (*Plum. Gen.* p. 9); 2. *Volubilis nigra, folio cordato nervoso* (*Sloan. Cat. Jam.* p. 46 and *Hist. Jam.* vol. i. p. 140); 3. but in this case doubtfully, *Rhizophora americana* (*Boerh. Ind. alt. Lugd.-Bat.* vol. ii. p. 267). The plants of Plumier and Sloane were West Indian species, one known to us from Plumier's figures (*Plum. Gen.* t. 26 and *Burm. Pl. Amer. Plum.* t. 117. fig. 1), the other from Sloane's original specimen still preserved in the herbarium at the British Museum;

that of Boerhaave was an American species grown in the open in the Leiden garden. In addition to the foregoing, Linnaeus included in this group of forms a plant growing in the garden of Mr. G. Clifford at Hartekamp which he had kept under observation during two successive seasons, but which had not flowered when the description given in the *Hortus Cliffortianus* was written. Facing the text (*Hort. Cliff.* p. 459) is a figure drawn by Ehret (*Hort. Cliff.* t. 28) to which Linnaeus makes no reference. This figure purports to be a portrait of the plant described by Linnaeus as *Dioscorea foliis cordatis alternis, caule laevi;* as, however, a prickle is shown at the base of one petiole and a fruiting raceme is depicted as arising from the axil of that particular leaf, we know that some modification must have taken place in the original drawing of the plant which, we learn from Linnaeus himself, had an unarmed stem and had failed to produce flowers.

In 1740 Royen (*Flor. Leyd. Prodr.* p. 527) repeated the synonymy of the *Hortus Cliffortianus*, citing the text but not the figure of 1737; the reference to the *Hortus Malabaricus* is also omitted by Royen, though Plukenet's notice of the Malabar plant is given.

In 1747 Linnaeus again dealt with *Dioscorea foliis cordatis alternis, caule laevi* (*Flor. Zeyl.* p. 170. n. 358) repeating the references of 1737, but omitting the expression of doubt used by himself in the *Hortus Cliffortianus* and by Royen in his *Prodromus*,* regarding the identity of *Rhizophora americana*, Boerh., and adding to his earlier citations that of *Rossakinda* from Burmann (*Thes. Zeyl.* p. 207). This *Rossakinda* is itself, as we learn from Burmann, whose work was published in 1737, taken up from Hermann (*Mus. Zeyl.* p. 27); the specimen of *Rasakinda*, the name of which appeared in 1717, is still in Hermann's herbarium at the British Museum and is the one written up, by Linnaeus himself, for the *Flora Zeylanica* (*Flor. Zeyl.* n. 358).

Like Royen in 1740, Linnaeus in 1747 cites his own text of 1737 (*Hort. Cliff.* p. 459) but does not refer to Ehret's figure (*Hort. Cliff.* t. 28). In 1753 (*Sp. Pl.* ed. 1. p. 1033), when the trivial name ' sativa ' was first proposed, Linnaeus at last acknowledged Ehret's plate as a figure of *D. sativa*, citing under the diagnosis the references *Hort. Cliff.* p. 459. t. 28; *Flor. Zeyl.* n. 358; and *Roy. Flor. Leyd. Prodr.* p. 527. The further references are now, however, reduced to three, those from Plumier, Sloane and Rheede, which are given in the order named; the references to Plukenet, Boerhaave and Burmann are omitted. In 1754 (*Amoen. Acad.* vol. iv. p. 133) Linnaeus accepted responsibility for the reference to *D. sativa* of *Olus sanguinis*, Rumph (*Herb. Amboyn.* vol. v. p. 482. t. 180), and in 1757 J. Burmann published the figure of Plumier's *Dioscorea scandens, foliis tamni, fructu racemoso* (*Pl. Amer. Plum.* p. 107. t. 117.

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* It is possible, however, that the omission of the ? in this instance may be an inadvertence; the text of n. 358 in the *Flora Zeylanica* contains several typographical errors which had escaped the notice of Linnaeus, *e.g. Pluk. Alm.* 32 in place of 321; *tammi* instead of *tamni*; *lugd.* i. p. 207 for ii. p. 267; *Herm. zeyl.* where *Burm. zeyl.* is intended. This being so, the ? may have been overlooked, or may have been ' dropped ' by the printer.

fig. 1), omitting the analytical details which had already been published by Plumier himself in 1703 (*Gen.* t. 26). We find accordingly, in 1759, the addition by Linnaeus of these two citations to his diagnosis of *D. sativa* (*Syst.* ed. 10. vol. ii. p. 1294). In 1763 (*Sp. Pl.* ed. 2. p. 1463) Linnaeus took up from Burmann's text of 1757 another reference, that by P. Browne (*Hist. Jam.* p. 360) to Plumier's West Indian plant. In 1767 (*Syst.* ed. 12. vol. ii. p. 656) and in 1770 (*Syst.* ed. 13. vol. iii. p. 656) Linnaeus amplified his diagnosis by adding the word *tereti*, in both instances repeating the citation of Rumph, but omitting the reference to Burmann's edition of Plumier. We may add here that in 1768 Burmann (*Flor. Ind.* p. 315)* dealt with *D. sativa* exactly as it was dealt with by Linnaeus in the *Species Plantarum*, ed. 2. p. 1462.

Summarising the various elements included by Linnaeus under *D. sativa* we find:—

1, an American *Dioscorea* described by Linnaeus in 1737 (*Hort. Cliff.* p. 459) the contemporary figure by Ehret assigned to which (*Hort. Cliff.* t. 28) was not accepted as valid by Linnaeus till 1753 (*Sp. Pl.* ed. 1. p. 1033);

2, a Ceylon plant collected by Hermann and published by him in 1717 as *Rasakinda*, republished by Burmann in 1737 as *Rossakinda* and finally written up by Linnaeus himself in 1747 (*Flor. zeyl.* n. 358) as *Dioscorea foliis cordatis alternis, caule laevi*;

3, a Malabar *Dioscorea* figured by Rheede as *Mu-kelengu* (*Hort. Malab.* vol. viii. p. 97. t. 51);

4, a West Indian *Dioscorea*, a figure of which by Plumier was published partly in 1703 (*Plum. Gen.* p. 9. t. 26), partly in 1755 (*Burm. Pl. Amer. Plum.* p. 107. t. 117. fig. 1), referred to by P. Browne in 1756 (*Hist. Jam.* p. 360) as the 'Wild Yam';

5, another West Indian *Dioscorea* cited from Sloane (*Cat. Jam.* p. 46 and *Hist. Jam.* vol. i. p. 140) as *Volubilis nigra, folio cordata nervoso*;

6, an Amboyna plant figured by Rumph as *Olus sanguinis* (*Herb. Amboyn.* vol. v. p. 481. t. 180).

These for the sake of brevity will be referred to below as *D. sativa*, Linn. [1], [2], [3], [4], [5], [6].

In addition to the six entities enumerated above, the specimens which represent *D. sativa* in the proper herbarium of Linnaeus have to be taken into account. There is only one specimen which has been written up as *D. sativa* by Linnaeus himself; this specimen he obtained from Kalm. The second specimen, pinned to the foregoing but not written up by Linnaeus, is an example of a West Indian and South American *Dioscorea*, frequently accepted as belonging to *D. polygonoides*, Humb. and Bonpl.,† and nearly allied to but easily distinguished from *D. sativa*, Linn. [4], the West Indian *Dioscorea* figured by Plumier. It differs from any of the elements of *D. sativa*, Linn., and may therefore be

* This is a printer's error for p. 215—the sheet of which the page forms part having been mispaged throughout.

† There is an element of doubt as to the precise identity of this plant owing to the circumstance that the name *D. polygonoides* is applied in herbaria to more than one species; we have so far failed to obtain access to an authentically named example of Humboldt and Bonpland's original plant.

neglected. The specimen which Linnaeus has written up as *D. sativa* with his own hand is a male example of the North American species named by himself *D. villosa* (*Sp. Pl.* ed. 1. p. 1033. n. 7). It differs from the Amboyna, the Malabar, the Ceylon, and both of the West Indian constituents of *D. sativa*, Linn.; it agrees as regards its foliage with the plant figured by Ehret (*Hort. Cliff.* t. 28) which professes to be *D. sativa*, Linn. [1], and there is nothing in its appearance or characters to separate it from the plant described by Linnaeus in the *Hortus Cliffortianus* in 1737 as *D. foliis cordatis alternis, caule laevi.*

In 1768 the name *D. sativa*, Linn., was used by Miller (*Gard. Dict.* ed. 8. No. 1) for a West Indian plant, seeds of which had been sent to England by Houston before 1733. In the field Houston had identified this with *Dioscorea scandens, foliis tamni, fructu racemoso.* The notes of Houston and the description supplied by Miller indicate that the plant intended is that figured by Plumier. *D. sativa*, Mill., is therefore certainly = *D. sativa*, Linn. [4], so far as Miller's description is concerned. But in Miller's Herbarium as in that of Linnaeus there are two specimens of *D. sativa;* in this case both have been written up by Miller himself. One of the two, evidently taken from a plant grown in the open is, as in the case of the Linnean collection, *D. villosa*, Linn.; the other, equally clearly derived from a stove-plant. is *D. sativa*, Linn. [4], the species whose seeds, Miller explains (*Gard. Dict.* l.c.), had reached him through Houston from Jamaica. In the Cambridge herbarium there is another specimen of the same stove-plant, given by Miller to Martyn.

In 1784 the name *D. sativa*, Linn., was used by Thunberg (*Flor. Japon.* p. 151) for a cultivated Japanese Yam, termed 'kasjuo kadsura.' This plant differs from all the elements included by Linnaeus under *D. sativa* and belongs instead to one of the two species included by Linnaeus under *D. bulbifera*, Linn. (*Sp. Pl.* ed. 1. p. 1033. n. 5). In Thunberg's own proper Herbarium, however, we find that he has also written up as *D. sativa* a specimen which is really referable to his own species *D. japonica.*

In 1788 the name *D. sativa*, Linn., was used by Gaertner (*Fruct.* p. 66) in such a manner as to include, so far as citations and references are concerned, all of the plants included by Linnaeus under *D. sativa* except *D. sativa*, Linn. [5], which is the West Indian *Dioscorea* taken up from Sloane. The description, however, is confined exclusively to the plant which is the subject of Gaertner's plate (*Fruct.* t. 17. fig. 4). That plate is a somewhat improved version of the one used by Plumier in 1703 (*Gen.* t. 26) to illustrate his *D. scandens, foliis tamni, fructu racemoso*, so that, strictly interpreted, *D. sativa*, Gaertn. (1788) is = *D. sativa*, Mill., as described in 1768, and = *D. sativa*, Linn. [4].

In 1789 the incidence of the name *D. sativa*, Linn. was critically discussed by Lamarck (*Encyc. Meth.* vol. iii. p. 232). He arrived at three definite conclusions:—

1, that Ehret's figure, published in 1737 and acknowledged for the first time by Linnaeus in 1753, must be regarded as the real basis of the name *D. sativa*, Linn.;

2, that the plant represented in Ehret's figure differs specifically from all the other elements included by Linnaeus under

D. sativa: Lamarck made no attempt to identify any one of these incongruous elements but he did particularly advert to the circumstance that the species with broad capsules figured by Plumier, which is *D. sativa*, Linn. [4], cannot possibly be conspecific with the plant figured by Ehret, which is *D. sativa*, Linn. [1];

3, that the plant figured by Ehret, not being one of the cultivated Yams, ought not to be designated 'sativa': this name Lamarck consequently rejected altogether, substituting for it the name *D. Cliffortiana*, Lamk (*Encyc. Meth.* l.c.).

Even as regards the identity of the plant which he thus named *D. Cliffortiana*, Lamarck was doubtful, though it appeared to him possible that it might be the plant, then represented only by male examples, which throve in the open in the Royal Garden at Paris and was known there in 1789 as *D. sativa*. This plant, Lamarck states, had all the characters of the *Dioscorea* from Florida figured by Plukenet (*Alm.* p. 46. t. 375. fig. 5), which was cited by Linnaeus in 1753 under *D. villosa*, Linn. (*Sp. Pl.* ed. 1. n. 7). We know now, what Lamarck probably did not know, that Miller may have held the same view, since one specimen written up by Miller as *D. sativa*, Linn., is *D. villosa*, Linn. We also know, what Lamarck certainly did not know, that Linnaeus himself was in like case, since the only specimen which he has written up as *D. sativa*—and he received that plant from Kalm prior to 1753—is his own *D. villosa*. It is more convenient to digress for the moment from the chronological sequence of our references and explain the fate which befel Lamarck's conclusions. Lamarck thought it desirable to prepare a plate to illustrate the genus *Dioscorea*, thus repeating a step which Plumier had already taken in 1703 (*Gen.* t. 26). The date of issue of Lamarck's plate is not quite clear, but is believed to have been about 1798. The plate itself shows (*Lamk. Ill.* t. 818) that he preferred to employ for the purpose figures already familiar to botanists rather than to provide drawings made from specimens of species less generally known. As illustrating a male *Dioscorea* he therefore employed an adaptation of one branch from Rheede's figure of *Mu-kelengu* (*Hort. Malab.* vol. vii. t. 51); as illustrating a female *Dioscorea* he was satisfied with a repetition of the version by Gaertner (*Fruct.* vol. i. t. 17. fig. 4) of the species chosen by Plumier (*Gen.* t. 26). Both of the species selected had been included by Linnaeus under *D. sativa* in 1753; they constitute *D. sativa*, Linn. [3] and *D. sativa*, Linn. [4], respectively. Both of them had, however, been explicitly excluded from *D. sativa*, Linn., in 1789, by Lamarck himself. In conformity with the decision at which he had then arrived we find that Lamarck refrained from suggesting on his plate a specific name for either of the species figured. In any case he was under no necessity to make such a suggestion: his immediate purpose was to illustrate the genus as a whole. The text deemed necessary to elucidate Lamarck's plate was not published until 1823. For this text Poiret, who continued Lamarck's studies, was responsible. In this text (*Tabl. encyc. Meth.* vol. iii. p. 429) Poiret states that Lamarck's plate (*Ill.* t. 818) represents *D. sativa*, Linn. This statement is in one sense correct, since of the two species there figured one is *D.*

sativa, Linn. [3], and the other is *D. sativa*, Linn. [4]; Poiret was quite entitled to accept, if he chose, the considered judgment of Willdenow, expressed in 1806, that the two plants concerned ought both to be included in *D. sativa*. But Poiret's preliminary statement, which is that this plate (*Ill. t.* 818) represents *D. Cliffortiana*, Lamk, is contrary to Lamarck's definite statement that *D. Cliffortiana* must be regarded as restricted to the species which forms *D. sativa*, Linn. [1], and is in opposition to Lamarck's explicit intimation that the two species there depicted, which are *D. sativa*, Linn. [3] and *D. sativa*, Linn. [4], should be excluded. Poiret's action, the responsibility for which has at times been attributed to Lamarck himself (conf. *Flor. Brit. Ind.* vol. vi. p. 296), is so unwarranted that it can only be explained as the result of inadvertence.

In 1796 the name *D. sativa* was applied by Rodschied (*Bemerk. Essequeb.* p. 57) to a *Dioscorea* found by him in Dutch Guiana. His specimens, from the words of Arowabisch, in which the plant is wild, were studied by G. W. F. Meyer in 1818, and were found to represent a species different from any of the elements included by Linnaeus under *D. sativa*. This species was described as *D. lutea*, Meyer (*Prim. Fl. Esseq.* p. 282), and when characterising it Meyer took occasion to endorse the view expressed by Lamarck in 1789, insisting in particular that the Amboyna plant of Rumphius, which is *D. sativa*, Linn. [6], must be excluded from the species intended by Linnaeus.

In 1806, Willdenow in re-editing the *Species Plantarum* made very little modification in the conception of *D. sativa* enunciated by Linnaeus. The West Indian species taken up from Sloane, *D. sativa*, Linn. [5], which Gaertner had not cited in 1788, was again included and the only Linnean element left out is the other West Indian species taken up from Plumier, *D. sativa*, Linn. [4]. With regard to this particular plant the argument advanced by Lamarck in 1789 could not be disregarded; it was accordingly transferred by Willdenow (*Sp. Pl. ed. Willd.* vol. iv. p. 795) to *D. piperifolia*, Humb & Bonpl.* There are, however, indications that Willdenow must have felt the difficulty with regard to the identity of *D. sativa* that had been experienced by Lamarck, by Miller and by Linnaeus himself. The sheet in Willdenow's own herbarium which has been written up as *D. sativa* is stated both by Grisebach (*Mart. Flor. Bras.* vol. iii. p. 43) and by Kunth (*Enum.* vol. v. p. 340) to bear the number 18422. According to Grisebach the specimen so numbered is the East Indian *D. deltoidea*, Wall. (Cat. Lith. n. 5110); according to Kunth this specimen is a male example, collected by Hunnemann, of that form of the North American *D. villosa*, Linn., which was described by Walter in 1788 as *D. quaternata* (*Flor. Carol.* p. 246). Unless there be two sheets in Willdenow's

* This involved the introduction of a new confusion owing to the circumstance, of which Willdenow does not appear to have been aware, that Plumier's plant, *D. sativa*, Linn. [4], twines to the left, has only three fertile stamens, and has seeds which are winged all round, whereas *D. piperifolia*, Humb. and Bonpl., twines to the right, has six fertile stamens and has seeds which are winged only at the top. In 1806, however, the taxonomic value of these morphological differences were not so fully appreciated as they are now.

herbarium, both bearing the number 18422, the two statements cannot be reconciled, though their joint testimony makes it clear that *D. sativa*, as understood by Willdenow, excluded *D. sativa*, Linn. [2], [3], [5], and [6] as well as *D. sativa*, Linn. [4]. Even the explicit exclusion by Willdenow of *D. sativa*, Linn. [4], appears to have produced little benefit if we may judge from the action of Aiton in 1813. Aiton's *D. sativa* (*Hort. Kew.* ed. 2. vol. v. p. 392), though by citation identical with *D. sativa*, Willd., is in reality the West Indian species, introduced by Houston, which was described as *D. sativa* by Miller in 1768. Now Houston's plant is the species figured by Plumier which constitutes *D. sativa*, Linn. [4], the solitary component of the Linnean species that Willdenow has been at pains to transfer to *D. piperifolia*, Humb. & Bonpl. Therefore *D. sativa*, Ait., and *D. sativa*, Willd., so far from being identical, are mutually exclusive. The citation by Aiton of Rheede's *Mu-Kelengu*, in place of mitigating, only accentuates this criticism, for Aiton claims that his *D. sativa* is a native of the West Indies whereas Rheede's plant is an Asiatic species.* The same confusion was perpetuated by Sweet (*Hort. Suburb.* p. 216) in 1818. Sweet's *D. aculeata*, introduced from India in 1803 and thought by him to be Rheede's *Kátu-Kelengú* (*Hort. Malab.* vol. vii. t. 37) was almost certainly the *Mu-kelengú*. His *D. sativa* on the other hand, which was introduced from the West Indies in 1733, though Sweet imagined it to be Rheede's *Mu-kelengu* (*Hort. Malab.* vol. viii. t. 51) was clearly the Houston-Miller plant.

In 1827 Blume used the name *D. sativa* (*Enum. Pl. Jav.* p. 23) for two plants from Java which he regarded as varieties of one species and considered to be conspecific with the *Mu-kelengu* of Rheede from Malabar. He cites in addition *D. sativa*, Willd., as defined in 1806, so that nominally his *D. sativa* should include the Linnean elements [1], [2], [3], [5], and [6]. He also cites Sprengel's reference of 1825 (*Syst.* vol. ii. p. 152) which is too general to be a guide. The description of *D. sativa* which Blume furnishes is incomplete; it gives no account of the tubers or of the floral structure. The account of the disposition, shape and especially the secondary venation of the leaves, renders it clear, however, that the plant before Blume must either have been the *Mu-kelengu* of Rheede, which he evidently believed it to be, or have been that species included by Linnaeus under *D. bulbifera* in 1753 which we have to regard as *D. bulbifera*, Linn. [1]. The statement that the leaves of the Java species are glabrous renders its identity with *Mu-kelengu* doubtful, since in *Mu-kelengu* the leaves are almost always more or less pubescent; the statement that the stem is unarmed strengthens this doubt, since it is rare for *Mu-kelengu* to be without prickles at least at the base of the petiole. Finally the statement that in the male of the Java species the spikes are fascicled and that in the female the spikes

* We make this remark nothwithstanding the circumstance that one species from Central America, *D. cymulosa*, Hemsl. (*Biol. Centr. Amer.* vol. iii. p. 355), was identified in 1892 with the *Mu-Kelengu* of Rheede. The particular plant with which *D. cymulosa* was then associated (*Flor. Brit. Ind.* vol. v. p. 291) is one from Burma (*Wall. Cat.* n. 5103 C, F) which in the first place is not the *Mu-Kelengu* (*Wall. Cat.* n. 5103 A, D, E) and further is not *D. cymulosa*.

are simple but crowded, renders the identification with *Mu-kelengu* impossible; in Rheede's plant the spikes in both sexes are always solitary. When we turn to the only other known Java species with transverse veins such as Blume attributes to the leaves of his plant, the difficulty disappears, for in that plant, which is *D. bulbifera*, Linn. [1], the leaves are always glabrous, the stem is unarmed, and it is moreover the only Java species in which we find a 'cluster' of simple female axillary spikes. The greatest difficulties connected with Blume's account of *D. sativa* are his statement that the male spikes are not only fascicled but paniculate, and the fact that he has described *D. bulbifera* as a species apart. So far as the latter difficulty is concerned it has, however, to be borne in mind that Roxburgh, an equally competent observer, felt justified in describing as distinct species, *D. pulchella* and *D. crispata*, what we now know to be only marked and readily distinguishable forms of *D. bulbifera*, Linn. [1]. As regards the former difficulty it has to be remembered that towards the ends of the flowering twigs of *D. bulbifera* the leaves in whose axils the fascicles of simple male-spikes arise, often are much reduced and sometimes are obsolete. When this occurs the postulated paniculate appearance is produced, and this condition is so frequent that Roxburgh, in his account of *D. crispata* (*Flor. Ind.* vol. iii. p. 802), describes the male flowers as panicled. Unfortunately there is no *Dioscorea* in the Leiden collection which has been written up by Blume himself as *D. sativa*. This defect is, however, remedied by the fact that in the Buitenzorg herbarium there is a specimen "ex herb. Blume" which is *D. bulbifera*, Linn., but which has been written up as *D. sativa*. It appears therefore as nearly certain as may be that the plant which Blume believed to be identical with the *Dioscorea* figured by Rheede as the *Mu-kelengu* was in reality *D. bulbifera*, Linn. [1], and that whatever his intention may have been Blume, without being cognisant of the fact, in 1827 used the name *D. sativa* as Thunberg had used it in 1784.

In connection with this question of *D. sativa* as understood by Blume, we may remark that in 1839 Dillwyn (*Rev. Ref. Hort. Malab.* p. 40) regarded *Mu-kelengu* as being *D. sativa*, Linn., and that in 1844 Hasskarl (*Cat. alt. Hort. Bogor.* p. 34) followed Blume so far at least as 'form' is concerned, though we have no means of judging whether *D. sativa*, Hassk. (1844), and *D. sativa*, Bl. (1827), be really the same plant. We do, however, know from its diagnosis that *D. sativa*, var. β, Hassk. was not the same plant as *D. sativa*, var. β, Bl.; from Hasskarl's indication it is obvious that his *D. sativa*, var. β, really was one of the forms of the *Mu-kelengu* of Rheede. We know, too, that in 1867 Hasskarl (*Hort. Malab. Clav.* p. 67) restricted the name *D. sativa* to *Mu-kelengu*.

In 1827 Presl applied the name *D. sativa* (*Rel. Haenk.* fasc. 2, p. 134) to a *Dioscorea* collected by Haenke in the mountains of Huanaco in Peru. From Presl's citations we find that he now definitely excluded from *D. sativa*, Linn., the Amboyna plant of Rumph, *D. sativa*, Linn. [6]. In thus following the advice given by Meyer in 1818, Presl went a step further and expressed the opinion that Rumph's plant is not a *Dioscorea* at all.

Presl also, at least in intention, excluded the West Indian species of Plumier, *D. sativa*, Linn. [4]; following Willdenow, he referred this to *D. piperifolia*, Humb. and Bonpl. But his action in this respect was imperfect; he cited Gaertner's figure and description under *D. sativa* Linn., without observing that the plant of Gaertner is also that of Plumier, so that according to Presl, *D. sativa*, Linn. [4], finds a place under two different species. What the actual species which Haenke collected and Presl described as *D. sativa* may be, is not clear; it certainly is no part of *D. sativa*, Linn., since none of the elements of that aggregate occur in Peru. It does not appear even to be identical with *D. sativa*, Rodsch. non Linn. (1796); at all events no Peruvian specimens of that species, which is *D. lutea*, Meyer (1818), have so far been met with by us.

In 1830 Maycock (*Flor. Barbad.* p. 390) restricted the name *D. sativa* to a single West Indian cultivated *Dioscorea*, other than *D. alata*, Linn., and other than *D. bulbifera*, Linn. Maycock excluded from *D. sativa*, the 'Wild Yam' of Browne l.c., footnote), which Willdenow had included, and in effect confined the name *D. sativa* to the *Volubilis nigra, radice tuberosa compressa*, whose identity with *D. cayenensis*, Lamk, is proved by Sloane's original specimen. But *D. cayenensis* sometimes is unarmed, at other times has the stem beset with prickles, and Maycock was led to regard these two states of this species as distinct. As a consequence he referred the armed condition of the species to *D. aculeata*, Linn., and thereby separated the *Volubilis nigra, radice tuberosa compressa* of Sloane from the *Dioscorea foliis cordatis, caule tereti aculeato* of Browne (l.c. p. 389, footnote). Maycock has, however, explained that he had no opportunity of informing himself how far the Yams actually cultivated in Barbados are distinct species or only varieties (l.c. p. 391, footnote), so that we do not know how far his judgment as to the difference between the plants of Sloane and Browne might have been modified by field-study. But Maycock at least shares with Blume the merit of having appreciated independently that, for the sake of convenience, if for no other reason, the name *D. sativa* should be applied to a cultivated Yam, and should, if possible, be restricted to only one Yam.

In 1831 Bunge used the name *D. sativa* (*Enum. Pl. Chin.* p. 64) for a cultivated Chinese Yam which differs from the cultivated Japanese Yam taken for *D. sativa* by Thunberg in 1784, and also differs from all the plants included under *D. sativa* by Linnaeus. *D. sativa*, Bunge, is the cultivated Yam known in Japan as 'Tsukne-imo,' first named by Thunberg in 1784. Thunberg's name, *D. opposita* (*Flor. Japon.* p. 151), having been overlooked, this garden plant was described by Turczaninow in 1837 as *D. polystachya* (*Bull. Imp. Soc. Nat. Mosc.* vol. xi. n. 7. p. 158). This name was in turn overlooked and the species was redescribed by Decaisne in 1854 as *D. Batatas* (*Rev. Hort.* sèr. 4. vol. iii. p. 243). What is a distinct cultivated form of the same species, not however differing sufficiently from the type to be regarded even as a variety, was described by Carrière in 1865 as *D. Decaisneana* (*Rev. Hort.* 1865, p. 111).

In 1832 the name *D. sativa*, Herb. Madras, was employed by

Wallich when distributing the herbarium collection of the East India Company (*Wall. Cat. Lith.* n. 5108). The specimen to which this name is given was collected by Rottler in Travancore in October, 1814; the field-note is inscribed:—" may be perhaps an autumnal state of *D. oppositifolia*, Linn., though the description does not tally." Another note attached to the specimen, also in Rottler's handwriting, bears the words " an *D. sativa*?" With this plant Wallich associated in his distribution six other gatherings (n. 5108 B–G) that do not now concern us, because Wallich does not vouch for their absolute identity with Rottler's plant. Fortunately there is no doubt as to what Rottler's *D. sativa* is, because Hooker has made it the type of the male portion of *D. Wallichii*, Hook. f. (*Flor. Brit. Ind.* vol. vi. p. 295). Since 1892, when Hooker's description was published, the species has been collected again by Bourdillon in Travancore, where it is known as *Katu-katsjil*. This name is one used by Rheede (*Hort. Malab.* vol. vii. p. 69. t. 36) for a female *Dioscorea* included by Linnaeus (*Sp. Pl.* ed. 1. p. 1033) under *D. bulbifera*. We know that the *Katu-katsjil* is not *D. bulbifera*, Linn. [1], because the basis of the Linnean species is a plant with stems twining to the left, with reflexed capsules that are longer than broad, and with seeds that are winged at the top only, whereas *Katu-katsjil* has, as Rheede's figure shows, stems that twine to the right and capsules that point forward and are rather broader than they are long; its seeds, as Rheede's description implies, are winged all round. The only difference between the *Katu-katsjil* as figured by Rheede, and *D. Wallichii* as described by Hooker, lies in the presence of axillary bulbils in Rheede's plant; so far we have found no trace of axillary bulbils in any of the numerous specimens of *D. Wallichii* examined by us. What is more often overlooked is that Rheede has figured and described as *Kattu-kelengu* (*Hort. Malab.* vol. vii. p. 71. t. 37) the male of the species of which *Katu-katsjil* is the female, the only difference between the two, apart from the sexual one, being that in *Kattu-kelengu* the stem is sparingly prickly, in *Katu-katsjil* it is unarmed. This circumstance has induced Linnaeus to regard *Kattu-kelengu* as the basis of his *D. aculeata* (*Sp. Pl.* ed. 1. p. 1033). In *D. Wallichii*, Hook. f., which nowadays certainly bears the name *Katu-katsjil*, we find that prickles may be present or absent in either sex, and this character, notwithstanding the importance attached to it by Linnaeus, is in many other species of equally slight significance. The character afforded by the presence of axillary bulbils, so clearly shown in both of Rheede's plates and so definitely insisted upon in Rheede's two descriptions, cannot, however, be disregarded. Nowhere in India have we been able to find a *Dioscorea* that agrees, as *D. Wallichii* does in every other respect, with the species figured by Rheede (l.c. tt. 36, 37) and at the same time produces axillary bulbils. If this character supplied by Rheede be strictly accurate, *D. aculeata*, Linn. [1] and *D. Wallichii*, Hook. f., must be accepted as specifically distinct. The adoption of this conclusion would, however, involve the acceptance of the hypothesis that since 1688 the incidence of the vernacular name *Katu-katsjil* has been altered. Students acquainted only with western peoples can point to

incidents of the kind; the name 'potato' which in England, when Shakespeare wrote, connoted *Ipomoea Batatas* and no other plant, is now among us exclusively restricted to *Solanum tuberosum*; the name 'pomme de terre,' now confined in France to this *Solanum*, was at the opening of the eighteenth century as rigidly restricted to *Helianthus tuberosus*. Those, however, whose experience has extended to Eastern races cannot fail to regard as singularly unlikely an assumption that there has been a change in the incidence of the name *Katu-katsjil*. Nor is such a hypothesis necessary. Regarding *Katu-katsjil* Rheede says:—"species est *Tsjagari-Nuren*, respectu radicis fructuum et verrucarum." No figure of the underground tuber is given in the case of either plant so that *respectu radicis* criticism is precluded. But when we examine the figure of *Tjageri-Nuren** (*Hort. Malab.* vol. vii. t. 33) which is the basis of *D. triphylla*, Linn. (*Sp. Pl.* ed. 1, p. 1032), we find it to be a *Dioscorea* with capsules longer than broad and with clavate, not spherical, axillary bulbils. In the case of *Kattu-kelengu* the account of the underground tuber accords with the characters met with in the tuber of *D. Wallichii*, though Rheede attributes to it properties more usually associated with the tubers of *D. bulbifera*, Linn. [1], a species which, though plentiful in Malabar, Rheede omits from his work. This circumstance suggests that the aerial tubers shown in the axils of the leaves of both *Katu-katsjil* and *Kattu-kelengu*, which agree with each other and with the aerial tubers of uncultivated *D. bulbifera*, may really have belonged to stems of the latter species which grew along with and were mistaken for those of *D. Wallichii*, Hook. f. This inadvertence, if it did take place, is easily explained. The flowering season of *D. Wallichii* is at the end of rains and therefore is considerably later than that of *D. bulbifera*, the leaves of which have largely disappeared, though the bulbils may remain attached to their bines, before the fruit of *D. Wallichii* has become so advanced as is shown in Rheede's figure of *Katu-katsjil*. We have, however, stronger evidence that the omitted *D. bulbifera* was confused with *Kattu-kelengu* in the circumstance that Rheede cites *Carando* as one of its synonyms. As Cooke has pointed out (*Fl. Bomb.* vol. ii. p. 758), *Kadu-Karanda* in Western India connotes the true uncultivated *D. bulbifera*, Linn. The error of placing the aerial tubers of a *Dioscorea* which is bulbilliferous in the leaf-axils of one which is not, was no more reprehensible on the part of Rheede's artist than the parallel inadvertence in the case of *Podara-kelengu* (*Hort. Malab.* vol. vii. p. 97, tt. 51, 52) where fruits of *Naravelia zeylanica* are shown as arising from the axils of the leaves of *D. hispida*, Dennst.† The latter inadvertence has not prevented the recognition of what *Podara-kelengu*

* For the difference in the two renderings of this name the *Hortus Malabaricus* is responsible.

† The converse of this old East Indian error took place, at a much later date, in the West Indies. In 1858 Marsh collected in Jamaica and distributed as his n. 1709 a mixture of the leaves of *Clematis dioica*, Linn. and the fruiting panicles of *Dioscorea martinicensis*. This undetected mélange was inadvertently made by Grisebach the basis of *D. triphylla*, Griseb. (*Flor. Brit. West Ind.* p. 587); non. Linn. nec Jacq. (1864).

is, nor does it seriously impair the value of Rheede's figure, which has been cited by Hooker (*Flor. Brit. Ind.* vol. vi. p. 289) under *D. daemona*, Roxb. The less serious inadvertence of adding the aerial tubers of *D. bulbifera* to the figures of the two sexes of another *Dioscorea* cannot prevent the citation of these figures under *D. Wallichii*, Hook. f., the species which, notwithstanding this error, they manifestly represent.* Since, however, one of these two figures is the basis of *D. aculeata*, Linn., published in 1753, it follows that the name *D. Wallichii*, which was not published until 1892, must be subordinated to *D. aculeata*. For the moment, however, our interest is confined to the circumstance, already made clear by Hooker (*Flor. Brit. Ind.* vol. vi. p. 296) that neither *Katu-katsjil* nor *Kattu-kalengu* can be included in the aggregate *D. sativa*, Linn., as built up during the period 1737-67.

In 1842 Grisebach described as *D. sativa*, Linn. (*Flor. Bras.* vol. iii. p. 43), a plant from Brazil which also differs from any of the elements included by Linnaeus in this species. The plant in question had been figured by Velloso in 1827 as *D. heptaneura* (*Flor. Flum.* vol. x. t. 124). Grisebach, unlike any of his predecessors from Willdenow onwards, was guided in his action by Lamarck; he excluded from *D. sativa*, Linn., everything save *D. sativa*, Linn. [1], the subject of Ehret's plate (*Hort. Cliff.*

* It may appear singular that an inadvertence so trivial as the addition to the figures of *Kattu-Kelengu* and *Katu-Katsjil* of the aerial bulbils characteristic of *D. bulbifera* should have obscured the identity of these plants longer than the more serious error of adding the fruits of a Clematid to the stem of a *Dioscorea* concealed the identity of *Podava-Kelengu*. Linnaeus became acquainted with that species through Rumph's figure of *Ubium sylvestre* (*Herb. Amboyn.* vol. v. t. 128) which he misidentified in 1754 (*Amoen. Acad.* vol. iv. p. 131) with Rheede's *Tsjageri-Nuren*, his own *D. triphylla*. But in none of his works did Linnaeus account for *Podava-Kelengu*. Burman (*Hort. Malab. index*) made no attempt to identify *Podava-Kelengu* in 1768. Roxburgh, who had received a plant from the Moluccas through C. Smith about the close of the eighteenth century, identified it with the *Ubium sylvestre* of Rumph, but failed to recognise its identity with *Podava-Kelengu*. In 1789 Lamarck (*Encyc. Meth.* vol. iii. p. 347) mistaking the *Naravelia* fruits for flowers, conjectured that it might be a *Trichosanthes*. Buchanan (afterwards Hamilton) who seems to have become acquainted with the plant itself during his Mysore journey in 1802–3, evidently without finding its fruit, thought it might be a *Smilax*. The plant is poisonous, hence Hamilton's names *S. virosa* and *S. narcotica*, first made public in 1832. In 1818, however, Dennstedt (*Schl. Hort. Malab.* pp. 15, 20, 33) recognised that *Podava-Kelengu* is a *Dioscorea* and named it *D. hispida*, Dennst. As this author has been careful at p. 33—the passage usually cited—to associate this name only with the first plate (*Hort. Malab.* vol. vii. t. 51) where no *Naravelia* fruits are shown, and as these fruits are not referred to in Rheede's text, *D. hispida* has to be regarded as the earliest unimpeachable one for the species, taking precedence over the name *D. hirsuta* employed by Blume in 1827 (*Enum. Pl. Jav.* p. 21) for *Ubium sylvestre*, Rumph. But Blume, like Dennstedt, recognised that *Podava-Kelengu* is a *Dioscorea*, which he named *D. hirsuta inflorescentia monstruosa*. This failure to recognise the true explanation of Rheede's second figure (*Hort. Malab.* vol. vii. t. 52) does not detract from the merit of Blume as the first author to recognise that *Ubium sylvestre* and *Podava-Kelengu* are conspecific. Since then no one save Kunth in 1850 (*Enum.* vol. v. p. 438, footnote) has expressed any doubt on the subject. In 1841, by some inadvertence, Steudel (*Nomencl.* ed. 2, vol. i. p. 511) reduced *D. hispida*, Dennst., to *D. cylindrica*, Burm. (*Flor. Ind.* 215 [315]), which is in reality *Ipomoea Batatas*. This error has somehow crept into the *Index Kewensis*.

t. 28); he believed that in *D. heptaneura*, Vell., he had at last found the missing species. But he did not accept the name *D. Cliffortiana* proposed by Lamarck in substitution for the original name *D. sativa;* he may have been influenced as regards this by his acceptance as correct of the erroneous statement made by Poiret that the plate showing two distinct species published by Lamarck (*Ill.* t. 818) to illustrate the genus *Dioscorea* was intended to be a portrait of the plant raised in 1737 in Clifford's garden at Hartekamp. There are other indications of haste in Grisebach's account of *D. sativa*. He states that in 1827 Presl had pointed out that an East Indian specimen named *D. sativa* in Willdenow's herbarium differs from the plant at that time, and still in Grisebach's day, grown in European gardens under the name *D. sativa*. There is no such statement in the passage by Presl to which Grisebach refers and the misquoted statement we have failed to trace. Grisebach indicates his belief that the specimen in question is *D. deltoidea*, Wall., which, as we learn from Sweet, had been introduced to European collections from Nepal in 1816.* If this identification be correct, the specimen cannot at the same time be *Olus sanguinis*, Rumph.,† as Grisebach states. The error into which Grisebach had been led as to the identity of the Brazilian species was corrected by Kunth in 1850, when he described it once more as *D. heptaneura*, Vell. (*Enum.* vol. v. p. 326). In 1864 Grisebach accepted Kunth's view (*Flor. Brit. West Ind.* p. 588) and now intimated that the Brazilian *D. sativa*, Griseb. non Linn. (1842), was identical with *D. lutea*, Meyer (1818) and thus, though he does not say this, with *D. sativa*, Rodsch. non Linn. (1796). This may be the case, because Grisebach indicates that he had examined an authentic example of Meyer's species, whereas Kunth remarks (*Enum.* vol. v. p. 413) that the relationship of *D. lutea* remained doubtful to him. The point, however, still remains obscure owing to the fact that, so recently as 1897, *D. heptaneura*, Vell. (1827), reduced by Grisebach in 1864 to *D. lutea*, Meyer, has been retained by Uline as a distinct species (*Engl. Pflanzenfam. Nachtr.* II.-IV. p. 86).

In 1845 Blanco employed the name *D. sativa*, Linn. (*Flor. Filip.* ed. 2. p. 551) for a *Dioscorea* which in 1837 he had himself described as *D. Tugui* (op. cit. ed. 1. p. 800). Merrill in 1905 (*Rev. Flor. Filip. Blanco*, p. 87) was able to prove that *D. Tugui*, Blanco, is the plant which in 1850 Kunth (*Enum.* vol. v. p. 401)

* The name used by Sweet was *D. nepalensis*, which cannot be taken up owing to the absence of a description. It was not used for the first time, as Hooker suggests (*Flor. Brit. Ind.* vol. vi. p. 297), in 1830 (*Sweet, Hort. Brit.* ed. 2, p. 522) but in 1827 (op. cit. ed. 1, p. 413) and must have been well-known in collections even prior to its earliest publication, since we find it applied by Jacquemont in the field to a specimen of *D. deltoidea*, Wall., now in the Paris herbarium, which was collected by that distinguished traveller in the North-west Himalaya in 1829.

† In 1818 Meyer had already shown that this Amboyna plant ought to be excluded from *D. sativa*, Linn., but without stating that it is not a *Dioscorea*. In 1827 Presl pointed out the latter circumstance. Presl's statement was confirmed in 1847 by Blume, who pointed out (*Rumphia*, vol. iii. p. 207, t. 177) that *Olus sanguinis* is a *Cardiopteris*. In 1872 this conclusion was confirmed by Baillon (*Adansonia*, vol. x. p. 280) and is evident to anyone who may examine the figure.

described as *D. tiliaefolia*, Kunth. But the plant of Blanco and Kunth is no more than a variety of the species to which Rheede's *Mu-kelengu* (*Hort. Malab.* vol. viii. t. 51) and the *Cumbilium* of Rumph (*Herb. Amboyn.* vol. v. t. 126) alike belong, although in 1753 Linnaeus referred the Malabar one to *D. sativa* (*Sp. Pl.* ed. 1. p. 1033) and in the following year placed the Amboyna one in *D. aculeata* (*Amoen. Acad.* vol. iv. p. 131).* *D. sativa*, Blanco (1845), is thus essentially the species to which in 1827 Blume intended to restrict the name *D. sativa*, Linn., and to which in 1839 Dillwyn succeeded in restricting it. Blanco's plant is therefore a form of *D. sativa*, Linn. [3].

In 1850 Kunth gave attention to *D. sativa* (*Enum.* vol. v. p. 340). The species is not formally stated by Kunth to be a doubtful one though his treatment indicates that it was such, because he has not provided a description; the account employed is taken verbatim from Blume (*Enum. Pl. Jav.* p. 23). The citations show that Kunth excluded from the Linnean aggregate *D. sativa*, Linn. [1], [4], [5], [6], retaining only the Ceylon plant (*Flor. Zeyl.* n. 358) which is *D. sativa*, Linn. [2] and the *Mu-kelengu* of Malabar, which is *D. sativa*, Linn. [3]. The transcript from Blume suggests that Kunth accepted Blume's description as applicable to these two plants but its inadequacy is shown by his citation of *D. sativa*, Blanco (*Flor. Filip.* ed. 2. p. 551) which, while in reality conspecific with *Mu-kelengu*, so that the citation is justified, is at the same time identical with the plant described by Kunth himself as *D. tiliaefolia* (*Enum.* vol. v. p. 401). In quoting the plate prepared by Lamarck to illustrate the genus (*Ill.* t. 818), Kunth for the first time pointed out the sources of its two components, but he did not call attention to the fact that the portion borrowed from Gaertner depicts *D. sativa*, Linn. [4], which Kunth had excluded from the species as understood by him, or advert to the circumstance that *D. sativa*, Ait. (*Hort. Kew.* ed. 2. vol. v. p. 392), which is cited in its entirety, really connotes *D. sativa*, Linn. [4] and has only, by its reference to *Mu-kelengu*, a casual connection with the species he was attempting to delimit. Various efforts have been made to follow Kunth. The citations employed by Miquel in 1859 (*Flor. Ind.-Bat.* vol. iii. p. 571) indicate one such attempt, but whether Miquel had in mind the plant to which Kunth endeavoured to restrict the name *D. sativa*, Linn., or rather had regard to the one to which alone the description given by Blume in 1827 applies, is not wholly clear. The use of the name *D. sativa* by Miquel in 1860 for a plant cultivated in

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* The name used for the species by Hooker (*Flor. Brit. Ind.* vol. vi. p. 291) is *D. spinosa*, Roxb. The reasons given by Hooker for declining to employ either the name *D. sativa* or the name *D. aculeata* are incontrovertible. The difficulty with regard to the name adopted by Hooker is that there is an earlier *D. spinosa*, Burm. (*Hort. Malab. index*, p. 5) used by Burmann in 1768 for Rheede's *Katu-Nuren-Kélengu* (*Hort. Malab.* vol. vii. t. 34), which Linnaeus for some reason did not cite in 1753. This plant is clearly only a form of *Nuren-Kelengu* (op. cit. vol. vii. t. 35) which was referred by Linnaeus to his *D. pentaphylla* (*Sp. Pl.* ed. 1, p. 1032). It seems clear that in proposing the name *D. spinosa* for a *Dioscorea* with simple leaves Roxburgh had overlooked or had failed to become acquainted with the existence of the name *D. spinosa*, Burm. (1768).

Sumatra (*Flor. Ind.-Bat. Suppl.* p. 270) points, however, rather to the Javan species described by Blume than to the Malabar one figured by Rheede as the species intended, and this is strongly confirmed by the use of the name *D. sativa* by Miquel in 1865 (*Prol. Flor. Jap.* p. 32) because we know that in this case Miquel intended, though he failed in his purpose, to connote the cultivated state of *D. bulbifera*, Linn. [1], for which Thunberg in 1784 had used the name *D. sativa*, Linn. In 1864, however, Thwaites (*Enum. Pl. Zeyl.* p. 326) interpreted Kunth's action as an attempt to confine the name *D. sativa*, Linn., to the plant figured by Rheede as *Mu-kelengu*. All the specimens from cultivated plants grown in Ceylon distributed by Thwaites as *D. sativa*, Linn., represent the plant which forms the subject of Rheede's plate. Perhaps the most interesting feature in Kunth's account of *D. sativa*, Linn., was his attempt, the first of its kind, to identify the various elements which he excluded from the species. For *D. sativa*, Linn. [1], he adopted the name *D. Cliffortiana*, Lamk (*Enum.* vol. v. p. 337) and like Lamarck based this on the description by Linnaeus and the figure by Ehret of a plant or plants from the Hartekamp garden (*Hort. Cliff.* p. 459. t. 28). But he accepted under *D. Cliffortiana* the statement of Poiret that Lamarck's figure (*Ill.* t. 818) is meant to represent the species that the plate by Ehret is supposed to represent. He has been led further into the inconsistency of citing this plate both under *D. sativa*, Kunth, which it does in part represent, and under *D. Cliffortiana* which it does not represent even in part. It is true that Kunth points out that the portion of the plate borrowed by Lamarck from Gaertner shows a plant with fruits unlike those shown in Ehret's figure. But he does not point out that the fruit borrowed from Gaertner belongs to a species distinct from that represented by the flowering twig borrowed from Rheede, and as regards the latter, which represents the *Mu-kelengu* of Malabar, Kunth says, under *D. Cliffortiana*, that it is a figure of a North American species.

Equal inconsistency is shown in the treatment of *D. sativa* [4], the West Indian plant taken up by Linnaeus from Plumier. Burmann's figure (*Pl. Amer. Plum.* t. 117. fig. 1) he regarded as the authority for the species which he nevertheless identified with *D. altissima*, Lamk, a name the basis of which is the companion figure on the same plate. But in another passage (*Enum.* vol. v. p. 356) he has cited fig. 1 under *D. piperifolia*, Willd. vix Humb. & Bonpl., and in yet another (*Enum.* vol. v. p. 412) has cited fig. 2, accurately, under *D. altissima*, Lamk. By inadvertence Kunth says that Gaertner had quoted fig. 2 where in reality he has referred to fig. 1; at the same time he omits to state that Gaertner's own figure (*Fruct.* t. 17. fig. 4) represents Plumier's plant.

Kunth has omitted to identify *D. sativa*, Linn. [5], the West Indian plant taken up by Linnaeus from Sloane, and although he has alluded to the discrepant views of Presl and Grisebach regarding the Amboyna plant which is *D. sativa*, Linn. [6], he has overlooked the identification of this plant by Blume in 1847 and has expressed no opinion of his own as to what it really is.

In 1864 these identifications by Kunth were revised by Grise-

bach (*Fl. Brit. West Ind.* p. 588). Again *D. sativa*, Linn. [1], was treated as *D. Cliffrotiana*, Lamk, but accepted as probably a form of *D. villosa*, Linn., the authority cited being Ehret's figure (*Hort. Cliff.* t. 28) but not the text which corresponds. The Ceylon plant (*Flor. Zeyl.* n. 358) which is *D. sativa*, Linn. [2], has not been alluded to by Grisebach. The Malabar plant, which is *D. sativa*, Linn. [3], is accepted as the basis of the Linnean species.

The West Indian plant taken up from Plumier, which is *D. sativa*, Linn. [4], and which was said by Kunth to be *D. altissima*, Lamk, is identified by Grisebach with *D. multiflora*, Presl, a species described in 1844. Though the identification in this instance is accurate it is not adequate, there being an older name for the species which was published by Sprengel in 1822, and there being another *D. multiflora*, Mart., published by Grisebach himself in 1842. The other West Indian plant, taken up from Sloane, which is *D. sativa*, Linn. [5], has been identified by Grisebach with *D. altissima*, Lamk. This identification cannot be accepted; Sloane's plant, the *Volubilis nigra, radice tuberosa compressa maxima digitata farinacea esculenta* is the well-known 'Negro Yam' of the West Indies, whereas *D. altissima*, Lamk, is Plumier's *Polygonatum scandens altissimum, foliis tamni* with, as its original reference to the genus *Polygonatum* as contrasted with *Dioscorea* implies, an elongated and nodose rhizome, not a digitate tuber. The figure of *D. altissima* (*Burm. Pl. Amer. Plum.* t. 117. fig. 2) shows moreover that its leaves have stipulary prickles; there are no such prickles in the 'Negro Yam' though the stem low down may be armed.* But Grisebach's treatment of *D. altissima* is not wholly consistent; on the previous page (l.c. p. 587) he referred it tentatively to *D. alata*, Linn.. which is the true 'Yam' as opposed to the 'Negro Yam' of the West Indies.

In dealing with *D. sativa*, Linn. [6], which he terms "the contested plant quoted from Rumph," Grisebach has neither

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* We take this opportunity to publish in full Plumier's description of the plant which in 1789 became the basis of *D. altissima*, Lamk (*Encyc. Meth.* vol. iii. p. 231) :—

Polygonatum scandens altissimum foliis tamni. Plumier MSS. tom. iii.

Radix hujus plantae arundinacea est nodosa scilicet geniculata et fibris duris tota compacta, caulículum unicum ut plurimum emittens altissime scandentem, lignosum, teretem, virentem et nodosum unde plurimae longissimae viticulae tenues diffunduntur etiam nodosae et ad singulos nodos binis foliis oppositis instructae cordatis membranaceis desuper e viridi lucentibus inferius vero paulo dilutioribus nervulisque instructis ut in plantagine vulgari a pediculo ad apicem percurrentibus inter quos venulae aliae jacent exiguae undulatae ac veluti parallelae. Singula folia palmam manus circiter sunt ampla pediculoque innituntur longiusculo et ad initium duobus apiculis mollibus instructo ex pediculorum autem alis longus propendit funiculus per totam longitudinem floribus instructus exiguis ipsi funiculo adpositis monopetalis campaniformibus tubulatis calycis expertibus sexque acuminibus dissectis deforis viridantibus et tomentosis, intus vero lutescentibus punctulis rubentibus signatis, tribusque apicibus subrotundis et virentibus stipatis.

Fructus maturos non vidi; plantam reperi junio apud insulam martinicensem.

attempted to identify the species nor alluded to the fact that Blume had already done so in 1847.*

In 1861 the name *D. sativa* was applied by Bentham (*Flor. Hong Kong.* p. 368) to that one of the two species included by Linnaeus under *D. bulbifera* which has capsules longer than broad and has seeds winged only at the top. In deliberately adopting this view Bentham does not appear to have been influenced by the circumstance that this usage had already been adopted by Thunberg in 1784, or to have considered the possibility that it was perhaps but a continuation of that followed by Blume in 1827, Hasskarl in 1844, and Miquel in 1859 and 1860. Apparently Thunberg identified this species with *D. sativa* because he found it cultivated in Japan as a crop. Bentham on the other hand did so because he regarded the plate by Ehret, published in 1737 (*Hort. Cliff.* t. 28) to be the basis of *D. sativa*, Linn., and because he considered this plate, which shows capsules that are longer than broad, a passable representation of the species with which he was dealing. He was, he has informed us, further actuated by a belief that the Linnean names *D. sativa* and *D. bulbifera* had been transposed by nearly all modern botanists.†

In 1865 the name *D. sativa* was employed by Miquel (*Prod. Flor. Jap.* p. 323) to designate a Japanese species which he believed to be the plant named *D. sativa* by Thunberg in 1784. The sheets written up by Miquel show that some of the specimens so named are actually referable to Thunberg's species, which is *D. bulbifera*, Linn. [1]. But the bulk of the material belongs to another species unknown to Thunberg. In 1879 Franchet & Savatier (*Enum. Pl. Jap.* vol. ii. p. 47) followed Miquel in this use of the name for a combination of two species. It was not until 1889 that the confusion created by Miquel and continued by Franchet was remedied; the species which these authors had in view was then adequately differentiated and characterised by Makino as *D. tokoro* (*Tokyo Bot. Mag.* vol. iii. p. 112 and *Ill. Flor. Jap.* t. 24).

In 1887 Trimen, in his concordance to the Ceylon herbarium of Hermann and the *Flora Zeylanica* of Linnaeus, had to point out (*Journ. Linn. Soc. Bot.* vol. xxiv. p. 151) that the plant collected by Hermann which is the authority for the citation by Linnaeus (*Flor. Zeyl.* n. 358) is *Tinospora cordifolia*, Miers. Trimen has

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* Before leaving the subject of *D. sativa*, Kunth, it may be noted that while Kunth has pointed out the existence of *D. sativa*, Bowdich (*Excurs. Mad.* p. 115) which is a *Tamus*, and of *D. sativa*, Sieber (*Cat. Pl. Aegypt.*) which is an *Anredera*, he has not alluded to *D. sativa*, Thunb. (1784) from Japan, or *D. sativa*, Bunge (1831) from China, or *D. sativa*, Herb. Madr. ex Wall. (1832) from Travancore, all of which are species of *Dioscorea*.

† A sequel to this belief of Bentham has been another formed by Hooker, that *D. bulbifera*, Linn., is unrecognisable (*Flor. Brit. Ind.* vol. vi. p. 296). The expression of these beliefs has given rise to a controversy which can be best examined when the incidence of the name *D. bulbifera*, as employed by Linnaeus and subsequent writers, is being discussed. The necessary examination the writers hope to make in another note. Since 1861 the usage advocated by Bentham was repeated by himself in 1873 (*Flor. Austral.* vol. vi. p. 461); by Hooker in 1892 (*Flor. Brit. Ind.* vol. vi. p. 295), by Uline in 1897 (*Engl. Pflanzenf. Nachtr.* II.-IV. p. 84), and again by Hooker in 1898 (*Trimen Handb. Flor. Ceyl.* pars iv. p. 461).

there assumed that "Linnaeus must have been well acquainted with *D. sativa* and his reference to it of these specimens of the very different 'Rasa-kinda,' *Tinospora cordifolia*, must be regarded as an inadvertence." The specimens have been the subject of other inadvertences. In 1893 Trimen himself became responsible for one of these in his statement (*Handb. Flor. Ceyl.* pars i. p. 40) that Linnaeus referred the specimens to the species which in 1753 he named *D. alata*; this is not the case, the citations under *D. alata* (*Sp. Pl.* ed. 1. p. 1033) are in the work of 1747 given under the next succeeding one (*Flor. Zeyl.* n. 359). Again in 1898 Hooker, overlooking the fact that the specimens in question (*Flor. Zeyl.* n. 358) had already been dealt with under *Tinospora cordifolia*, repeated their citation under *D. sativa* (*Handb. Flor. Ceyl.*, pars iv. p. 278).

The subjoined brief summary of the results of our bibliographical study, checked by an examination of such herbarium material as is available, shows how the name *D. sativa* has been employed by various authors since 1753.

Conspectus of usage of the name D. Sativa, Linn.

D. sativa, *Linn.* (1753) includes *D. sativa* [1] [2] [3] [4] [5];
D. sativa, *Linn.* (1754) is applied to *D. sativa* [6];
D. sativa, *Linn.* (1759) includes *D. sativa* [1] [2] [3] [4] [5] [6];
D. sativa, *Burm.* (1768) includes *D. sativa* [1] [2] [3] [4] [5] [6];
D. sativa, *Mill.* (1768) is restricted by description and geography to *D. sativa* [4];
D. sativa, *Thunb.* (1784) is applied to *D. bulbifera*, Linn. (1753) [1];
D. sativa, *Gaertn.* (1788) is restricted by description and illustration to *D. sativa* [4];
[*D. sativa*,] Lamk (1789) is restricted to *D. sativa* [1] and employed as a synonym of the newly proposed name *D. Cliffortiana*, Lamk (1789);
D. sativa, *Rodsch.* (1796) is applied to a Guiana plant afterwards described as *D. lutea*, Meyer (1818);
D. sativa, *Willd.* (1806) includes *D. sativa* [1] [2] [3] [5] [6] while [4] is omitted;
D. sativa, *Ait.* (1813) is restricted by geography to *D. sativa* [4];
D. sativa, *Sieb.* (1821) is applied to a species of *Anredera*.
D. sativa, Poir. (1823) is restricted by illustration to *D. sativa* [3] [4] but is by inadvertence treated as a synonym of *D. sativa* [1] under the name *D. Cliffortiana*, Lamk (1789);
D. sativa, *Bowd.* (1825) is applied to a *Tamus* of Madeira.
D. sativa, *Presl* (1827) is applied to a Peruvian plant whose identity is not known, but which may be allied to *D. lutea*, Meyer (1818);
D. sativa, *Blume* (1827) is applied to a Javanese plant whose identity is uncertain, but which may be *D. bulbifera*, Linn. [1];

D. sativa, *Maycock* (1830) is applied to the unarmed condition of *D. sativa*, Linn. [5];
D. sativa, *Bunge* (1831) is applied to *D. opposita*, Thunb. (1784);
D. sativa, *Rottler* (1832) is applied to *D. bulbifera*, Linn. [2] (1753) afterwards described as *D. Wallichii*, Hook. f. (1892);
D. sativa, *Dillwyn* (1839) is restricted by citation to *D. sativa* [4];
D. sativa, *Griseb.* (1842) is applied to the Brazilian *D. heptaneura*, Vell. (1827);
D. sativa, *Blanco* (1845) is applied to a form of *D. sativa* [4];
D. sativa, *Kunth* (1850) is restricted in intention to *D. sativa* [2] [3], though Kunth's citation of Blume involves the probable inclusion of *D. bulbifera* [1], while *D. sativa* [1] is kept apart as a synonym both of *D. quaternata*, Walt. (1788) and of *D. Cliffortiana*, Lamk (1789);
D. sativa, *Benth.* (1861) is restricted to *D. sativa* [1] which is treated as identical with *D. bulbifera*, Linn. [1] (1753);
D. sativa, Griseb. (1864) is treated as a synonym of *D. lutea* Meyer (1818) which is now considered to be identical with *D. heptaneura*, Vell. (1827);
D. sativa, *Thw.* (1864) is deliberately confined to *D. sativa* [4];
D. sativa, *Miq.* (1865) is applied mainly to a Japanese plant afterwards described as *D. tokoro*, Makino (1889).
D. sativa, *Hassk.* (1867) is restricted by citation to *D. sativa* [4].

When the question as to the identity of the six different plants included by Linnaeus under *D. sativa* in 1753 and 1754 is considered regard must be had to the conclusion of Lamarck in 1789, Grisebach in 1842, Bentham in 1861 and Hooker in 1892 that the figure by Ehret published in 1737 (*Hort. Cliff.* t. 28) must be accepted as the authority or basis for the name, and to the fact that the only authors who have taken a different view have been possibly Blume in 1827* and certainly Kunth in 1850. As Kunth has, in intention at least, restricted the use of the name to the plant especially cited by Blume, which is the Malabar *Mu-kelengu* of Rheede, it is desirable to defer the consideration

* Rottler, whose tentative use of the name *D. sativa* in the Madras herbarium has been adopted by Wallich, may have held the view that *D. sativa* should be restricted to a single plant among the six included under the name by Linnaeus; so, for anything they say, may Thunberg, Bunge and Miquel. As, however, all four authorities have used the name *D. sativa* for species which lie outside the Linnean aggregate, their views may be neglected here. The case of Blume is on a somewhat different footing, in the first place because he believed himself to be using the name for a single species which is included in the Linnean aggregate, and further because Kunth, by transcribing the definition drawn up by Blume, has indicated fairly clearly that he was guided by Blume's judgment in his selection of the particular Linnean element of *D. sativa* to which that name should be restricted. The fact that the plant actually described by Blume cannot possibly be the Linnean element in question, or indeed be any of the six species included in *D. sativa* by Linnaeus, does not affect the manifest intention of Kunth, which was anticipated by Dillwyn in 1839 and to which logical effect was given by Thwaites in 1864 and by Hasskarl in 1867.

of Rheede's and Ehret's figures until the remaining four plants have been disposed of.

Of the four plants in question two are from the East Indies as understood by Linnaeus; the other two are West Indian species. The former are (1) a Ceylon plant collected by Hermann and published on his authority as *Rasa-kinda* or *Rossa-kinda*, which forms the basis of one of the Linnean citations (*Flor. Zeyl.* n. 358) under *D. sativa* in 1753 (*Sp. Pl.* ed. 1. p. 1033); and (2) an Amboyna plant figured by Rumph as *Olus sanguinis*, which was referred by Linnaeus to *D. sativa* in 1754 (*Amoen. Acad.* vol. iv. p. 133). Both of these Asiatic plants exclude themselves from *D. sativa*, however it may ultimately be decided to apply that name, because neither of them belongs to the genus *Dioscorea*. The Ceylon plant is a species of *Tinospora* (*Trim. Journ. Linn. Soc. Bot.* vol. xxiv. p. 151); the Amboyna plant is a *Cardiopteris* (*Blume, Rumphia*, vol. iii. p. 207. t. 177). The two West Indian plants are both members of the genus *Dioscorea*; they are (1) a Martinique wild plant first recorded by Plumier and named by him *Dioscorea scandens foliis tamni, fructu racemoso;* and (2) a Jamaica cultivated plant named by Sloane *Volubilis nigra radice tuberosa compressa maxima digitata farinacea esculenta folio cordato nervoso*. With the earliest citation of the Martinique species in 1703 Plumier published a plate showing the fruit (*Gen.* p. 9. t. 26); the main-figure by Plumier of the same plant was published in 1755 by Burmann (*Pl. Amer. Plum.* t. 117. fig. 1). The actual specimen which is the basis of Sloane's diagnosis of 1696 (*Cat. Jam.* p. 46) is still in the Sloane herbarium. A comparison of the material in herbaria tallying with the figure by Plumier and the specimen of Sloane respectively, shows that the Martinique plant twines to the left and has reflexed capsules, whereas the Jamaica plant twines to the right and has forward-pointing capsules; the leaves of the Jamaica plant, moreover, while very often alternate on secondary branches are opposite on the main bines and on most primary branches, those of the Martinique plant are always alternate; the flowers, too, differ considerably, those of the Martinique plant have membranous bracts and bracteoles and a membranous perianth with only three fertile stamens alternating with three staminodes, the anther-cells being discrete,* whereas those of the Jamaica plant have firm almost hyaline bracts and bracteoles, a thick and somewhat fleshy perianth with six fertile stamens, the anther-cells being contiguous. There is therefore no question that the two West Indian plants included by Linnaeus under *D. sativa* belong to two distinct species.

The species figured by Plumier was transferred by Willdenow in 1806 to *D. piperifolia*, Humb. and Bonpl. Willdenow's treatment was followed by Poiret in 1813 (*Encyc. Meth. Suppl.*

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* The original Plumierian drawing (*MSS.* tom. ii. n. 144) includes some at least of the analytical details contained in Plumier's plate of 1703 (*Gen.* t. 26). These were not made use of by Burmann (*Pl. Amer. Plum.* t. 117. fig. 1) possibly owing to their having already been published. In the original drawing, underneath the figures of the male flower, we find the legend 'fleur blanche, en clochette, découpée en 6 parties, 3 étamines à double teste.'

vol. iii. p. 138), by Presl in 1827 (*Rel. Haenk.* fasc. 2. p. 134), and by Grisebach in 1842 (*Flor. Bras.* vol. iii. p. 27). So far these references had regard only to Plumier's illustration. Kunth's treatment of this plate under *D. satira* has already been adverted to; in another place (*Enum.* vol. v. p. 336) he did expressly exclude Plumier's plant from *D. piperifolia*, but he did not even there definitely identify it with a known species. It is to Grisebach that we owe the reference of the plant figured by Plumier to a properly characterised species, though his treatment still leaves something to be desired. In 1864 (*Flor. Brit. West Ind.* p. 587) he identified it with a Martinique plant which Presl had named *D. multiflora* in 1844 (*Bemerk.* p. 116), overlooking when he did so that he himself had already published a different *D. multiflora*, Mart., in 1842 (*Flor. Bras.* vol. iii. p. 35).*

The bibliographical history of this Martinique plant has been rather chequered. The plant was collected by Kohaut on behalf of Sieber and was issued by the latter, at first without a specific name (*Herb. Mart.* n. 27), in 1821. A specimen which reached Sprengel was described by that author in 1822 as *D. martinicensis* (*Neue Entdeck.* vol. iii. p. 17).† Shortly afterwards Sieber himself issued a list in which it was identified with *D. altissima*, Lamk (*Herb. Mart. Suppl.* n. 27). In 1825 Sprengel accepted this determination and treated his *D. martinicensis* as identical with *D. altissima*, Lamk (*Syst.* vol. ii. p. 153). Presl in 1844 recognised the error, but unfortunately overlooked the existence of the name *D. martinicensis*, Spreng. (1822) for the species he was describing and of the name *D. multiflora*, Mart. (1842) for another species. Kunth in 1848 while overlooking the former inadvertence detected the latter; to remedy it he suggested that the Martinique plant be termed *D. Sieberi* (*Act. Acad. Berol.*

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* The difficulty caused by the existence of the name *D. multiflora* in connection with two distinct species was pointed out in 1916 by Hauman (*Anal. Mus. Nac. Hist. Nat. Buenos Aires*, vol. xxvii. p. 458, footnote).

† That the Martinique plant of Plumier is the same as the Martinique plant of Sieber is evident from a comparison of Kohaut's specimens with Plumier's plate and is confirmed by the comparison of Plumier's original description, here reproduced, with those of Sprengel and Presl and Kunth. Plumier's account is as follows :—

Dioscorea scandens foliis tamni fructu racemoso Plumier MSS. tom. ii. fig. 144.

Huiusce planta radix radicis Bryoniae vulgaris in modum carnosa non napiformis quidem sed in ramos et in appendices distenta, tenera candida multoque sapore conspicuo donata. Cauliculum unicum producit tenuissimum sed lentum alteque supra vicinas arbores scandentem et ramos plurimos emittentem etiam longissimos et tenuissimos quibus inhaerent ampla folia cordata tamni vulgaris foliis perquam conformia sed ampliora, nervosiora, obscurius aliquantulum virentia et amariuscula longis annectuntur pediculis longus appendet floribus onustus exiguis candidis monopetalis campaniformibus patentibus et in sex segmenta divisis, ac senideni tribus staminulis bicipitibus instructis. Ex calyce autem perquam exiguo surgit pistillum quod infimam floris partem perfodit abitque deinde in fructum trigonum et in tria loculamenta multum compressa et fere semicircularia divisum, seminibus foeta planis orbiculatis et marginatis et amarissimis.

Multoties plantam reperi variis in locis insulae martinicanae potissimum in illa regione quae vulgo le Mont Hoel dicitur ad partes arcis Divo Petro dicatae.

1848 p. 58). Kunth had not then decided to establish his genus *Helmia* for those species of *Dioscorea* in which the seeds are winged only at the top. When he took this step, *D. multiflora*, Mart. (1842), automatically became *Helmia multiflora*, Kunth (*Enum.* vol. v. p. 431), and the name *D. multiflora*, Presl (1844), once more became available (*Enum.* vol. v. p. 333). When in 1864 Grisebach pointed out the identity of this Martinique plant with the subject of Plumier's plate he did, however, introduce a minor confusion owing to his having described as *D. triphylla*, Linn. (*Flor. Brit. West Ind.* p. 587)* what as regards foliage is *Clematis dioica*, Linn., and as regards the compound fruiting spikes is *D. martinicensis*, Spreng.

So far as may be judged from the specimens preserved in the collections at Kew and the Natural History Museum, London, the plant known as *D. martinicensis*, Spreng., is confined to the West Indies. It is a member of the section *Lychnostemon*, and within that section is most nearly allied to *D. meridensis*, Kunth, a species from Colombia with leaves equally closely reticulated and with the inflorescences similarly branched. But while so like *D. martinicensis*, the Colombian plant is readily distinguished from the West Indian one by being everywhere puberulous. Plentiful in Martinique and St. Vincent, *D. martinicensis* is equally abundant in Jamaica.† In Dominica the

* Grisebach's account of *D. triphylla* is perplexing in other ways; he states that his conglomerate plant is "naturalised in Jamaica." There is no such statement on the sheet of *March* n. 1709, which Grisebach has written up as *D. triphylla*, Linn. Grisebach's account of the *Clematis* leaves and of the *Dioscorea* capsules is accurate; to what plant the citation "3 stamens fertile" may apply, is not clear. The citation of the plate of *D. triphylla* of 1793 by Jacquin (*Ic. Pl. Rar.* t. 627) at first suggests that the species Grisebach had in mind was *D. triphylla*, Linn. of 1754 (*Amoen. Acad.* vol. iv. 131), which is *D. hispida*, Dennst. (1818), rather than the *D. triphylla*, Linn. of 1753 (*Sp. Pl.* ed. 1, p. 1032) which, as Linnaeus anticipated when he first published this name, now proves to be only a form of *D. pentaphylla*, Linn. Against this, however, is the fact that the *D. triphylla* figured by Jacquin has 6 fertile stamens, and that the good description of the fruit of this species by Gaertner (*Fruct.* vol. i. p. 66) does not in the least agree with Grisebach's account of the capsules of the West Indian plant. The other *D. triphylla*, Linn., which is but a form of *D. pentaphylla*, has, it is true, only 3 fertile stamens. But in this case again the fruits are quite unlike those described by Grisebach. Moreover, neither the *D. triphylla*, Linn. of 1754, nor the *D. triphylla*, Linn. of 1753, are naturalised in Jamaica. The only *D. triphylla* of which this might perhaps be said, is the *D. triphylla* described by Poiret in 1813 (*Encyc. Meth. Suppl.* vol. iii. p. 140). The name *D. triphylla*, Poir., however, is merely a typographical error for *D. trifida*, Linn. f., a species described in 1781 by the younger Linnaeus (*Suppl. Pl.* p. 427—not p. 224 as stated by Poiret, l.c.) from a specimen collected by Allamand in Surinam, which still exists in the Linnean herbarium. This species was described again in 1789 by Lamarck as *D. triloba* (*Encyc. Meth.* vol. iii. p. 234), and once more in 1806 by Willdenow as *D. brasiliensis* (*Sp. Pl. ed. Willd.* vol. iv. p. 791).

† Though so common in Jamaica the species is not dealt with by Sloane. It is the Wild Yam of P. Browne (*Nat. Hist. Jam.* p. 360) who adverts to its relatively large capsules, as compared with those of the Yam (*D. alata*, Linn.) and the Negro Yam (*D. cayenensis*, Lamk), the only other species which Browne deals with. Browne cites under it *Dioscorea foliis cordatis caule laevi* of the *Hortus Cliffortianus* (*D. sativa*, Linn.), but by inadvertence cites also the *Fegopirum scandens seu volubilis nigra majus* of Sloane (*Cat.* 46: *Nat. Hist. Jam.* vol. i. p. 131, t. 90, fig. 1) which is *Anredera scandens*, Moq. (*Grisebach, Flor. Brit. West Ind.* p. 60).

place of *D. martinicensis* is taken by a *Dioscorea*, known there as the 'Yam Poule,' with leaves that in shape and size resemble those of the Martinique and Jamaica plant, but differ in being widely reticulated and in subtending simple spikes. This plant is included by Grisebach in *D. multiflora*, Presl, which is *D. martinicensis*, Spreng. By others it is included in *D. polygonoides*, Humb. and Bonpl., a South American species, and it may perhaps be identical with the unnamed plant that has been attached in the Linnean herbarium to the one there written up as *D. sativa*. But it is certainly not the species accepted by Kunth as *D. polygonoides* and cannot even be regarded as a variety of Kunth's plant so named. Whether the 'Yam Poule' be specifically distinct from *D. martinicensis* or not is a point that can only be settled when the two are grown experimentally side by side. Even if it should prove to be referable to Sprengel's plant it must be regarded as a very marked variety.

The history of the second West India species included by Linnaeus under *D. sativa* has not been quite so complicated as that of *D. martinicensis*, Spreng. It was taken up by Linnaeus from Sloane's accounts of 1696 (*Cat.* p. 46) and 1707 (*Hist. Jam.* vol. i. p. 140). In the latter work Sloane terms this the *Negro* Country *Yam*, as opposed to the *Yam* or *Yammes* proper (*D. alata*, Linn.); by his remark 'swine are fatted with these roots in Zeylan,' Sloane shows that he took it to be a species grown in Ceylon, 'ubi porci cum radicibus saginantur' which Commelin believed to be the *Mu-kelengu* of Rheede. Linnaeus, who had not seen a specimen of the 'Negro Yam,' appears to have regarded Sloane's surmise as an ascertained fact, hence his reference to the same species of two plants so dissimilar as the *Mu-kelengu* of Malabar and the *Negro* country *Yam* of Jamaica. P. Browne in 1756 also terms Sloane's plant the 'Negro Yam,' but by his citation under this name of *Dioscorea foliis cordatis caule tereti aculeato bulbifero* shows that he did not agree with Linnaeus and that he considered it to be more naturally placed in *D. aculeata*, Linn. than in *D. sativa*, Linn. Since the stems of the Negro Yam are very often armed low down, this judgment was a natural one on the part of an author thoroughly familiar with the plant as it grows, who had no apparent anxiety to establish a new species. After Browne, however, little attention seems to have been paid to this plant. Lamarck, and other subsequent writers, expressly or implicitly excluded Sloane's plant from *D. sativa*, but no one after Browne attempted to identify the plant of Sloane until Grisebach in 1864 hazarded the suggestion that it is *D. altissima*, Lamk. An examination of Sloane's original specimen shows that it represents the species which is still known in Jamaica as the 'Negro Yam.' This species was described for the first time in 1789 by Lamarck as *D. cayenensis** (*Encyc. Meth.* vol. iii.

* The name *cayenensis* was inadvertently printed *cajennensis* by Willdenow in 1806 (*Sp. Pl. ed. Willd.* vol. iv. p. 791). This was changed to *cayennensis* by Sprengel in 1825 (*Syst.* vol. ii. p. 152), and his orthography has been followed by Grisebach, Kunth and others. There is nothing to show why Sprengel, when correcting one of Willdenow's typographical errors, should have accepted the other. Attention was directed to the correct spelling in the *Index Kewensis* in 1893, but with little result; the erroneous Sprengelian form was again adopted by Uline in 1896 (*Engl. Bot. Jahrb.* vol. xxii. p. 431).

p. 323), and in another form was redescribed by Poiret in 1813 as *D. rotundata* (*Encyc. Meth. Suppl.* vol. iii. p. 139). Maycock in 1830 regarded the armed and the unarmed conditions of *D. cayenensis* as specifically distinct, treating the former as *D. aculeata*, Linn., and the latter as *D. sativa*, Linn. (*Flor. Barbad.* pp. 389, 390). According to Grisebach (*Flor. Brit. West Ind.* p. 587, the species described by Kunth in 1850 as *D. Berteroana* (*Enum.* vol. v. p. 381) is also *D. cayenensis*. According to Kunth, Balbis had formally proposed the adoption of P. Browne's determination of 1756 and had named the species *D. aculeata*. Kunth appears to have doubted whether the *D. cayenensis* described by Grisebach in 1842 (*Flor. Bras.* vol. iii. p. 33) be really the species described by Lamarck, and the statement by Grisebach that in his plant the stamens are attached at the apex of a corolla tube certainly justified Kunth's caution. On the other hand the agreement in other respects, and particularly the reference by Grisebach to an error in the original description, which shows that the firm and glistening bract and bracteoles were mistaken by Lamarck for a calyx, render it probable that Grisebach's plant is really that of Lamarck. Grown largely, as its name implies, in former days to provide food for Negro slaves in the West Indies and in South America, it is possible that this plant may not be a native of the New World, but may have been shipped from Africa as food* for those who had to endure the horrors of the middle passage and did not all survive. In 1896 Uline definitely claimed it as an Old World plant. It certainly is not Asian, and if it be African—it is very closely allied to the African *D. prehensilis*—Uline has not indicated where or by whom it has been collected

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* Clusius has referred in 1601 (*Rar. Pl. Hist.* lib. iv. p. lxxix.) to a specific instance of this practice. A consignment of slaves purchased in the island of S. Thomé, off the Gaboon coast, in 1596, was being shipped to Lisbon for resale. The ships on which the slaves were to be sent all came to Walcheren in Holland. Through Parduyn, a burgess, and Roëls, a physician of Middelburg, Clusius obtained specimens of the *Dioscorea* tubers intended as food for these slaves on the voyage. Clusius found that they were of two sorts. His account of them is interesting, but unluckily his evidence is negative so far as the origin of *D. cayenensis* is concerned. One kind had the name *Igname* or *Inhame*; the description tallies with that of some race of *D. alata*, Linn. In 1648 there appeared a description by Marcgraf, under the name *Inhame de S. Thomé*, of *D. alata* as grown in Brazil. We may therefore feel certain that this *Inhame* of Clusius really was the 'Greater Yam.' But the 'Greater Yam' originated in Asia and all we learn from Clusius is that by the end of the sixteenth century this Asiatic species had reached West Africa. The second kind was also termed *Inhame* by the Portuguese merchant who handed the tubers to Parduyn. But Clusius had learned somehow that others termed this second kind *Ycam Peru*. *Ycam* is an African name for an edible *Dioscorea*. But while it may be assumed that those who used the name were aware of this fact, the qualifying term shows that in their judgment the plant was not the African species to which the name properly belongs but an exotic which they believed, rightly or wrongly, to be a native of South America. The African *Akam* is *D. latifolia*, Benth., a Yam nearly allied to, if not indeed a variety of *D. bulbifera* Linn. The name has reached the West Indies, where the cultivated *D. bulbifera* is known as *Acom*. But both in Africa and in the New World *Ycam* or *Akam* or *Acom* connotes a member of the section *Opsophyton* and is not applied to any species of the section *Enantiophyllum*, to which both *D. alata* and *D. cayenensis* belong.

on the Dark Continent. As Uline (*Engl. Nat. Pflanzenfam. Nachtr.* II.–IV. p. 85) uses the name *D. spinosa*, Roxb., for the Ceylon plant, referred to by Commelin, which Sloane supposed to be the Negro Yam, his judgment regarding the Old World origin of *D. cayenensis* should rest on some basis other than that which influenced Sloane and misled Linnaeus.

When we come to the Malabar plant figured by Rheede as *Mu-kelengu* we have to deal with another complication. The authors who have cited Rheede's figure under *D. sativa*. Linn. include some, like Burmann in 1768, Willdenow in 1806 and Presl in 1827, who have treated the plant it represents as merely one form of a more or less variable species; and others, like Gaertner in 1788, Aiton in 1813, Blume in 1827 and Kunth in 1850, who by their descriptions or by some other indication, have shown a desire to confine the name *D. sativa*, Linn. to a single well-characterised form. The species with which Gaertner and Aiton believed *Mu-kelengu* to be conspecific we now know to be the West Indian *D. martinicensis*, Spreng.; that with which Blume identified *Mu-kelengu* we believe to have been *D. bulbifera*, Linn. [1]. In the case of Kunth the intention to restrict the name *D. sativa* to the *Mu-kelengu* of Rheede (*Hort. Malab.* vol. viii. p. 97. t. 51), though not satisfactorily carried out, is very manifest. At last in 1864 the limitation aimed at was definitely accomplished by Thwaites (*Enum. Pl. Zeyl.* p. 326, note). However, as Hooker has shown, the name *D. sativa* cannot be used for the species represented in Rheede's figure of *Mu-kelengu*, notwithstanding the citation of that plate by Linnaeus, because the figure by Ehret (*Hort. Cliff.* t. 28) cited by Linnaeus in 1753 must be accepted as the basis of *D. sativa*, Linn. (*Flor. Brit. Ind.* vol. vi. p. 291).

This, however, is not the only point connected with the plant now being considered in respect of which we are indebted to Hooker. To him we owe the recognition in 1892 for the first time of the important fact, overlooked by Linnaeus, that the *Mu-kelengu* of Rheede is conspecific with the plant figured by Rumph as *Combilium* (*Herb. Amboyn.* vol. v. p. 357. t. 126). As a result of this oversight Linnaeus in 1754 (*Amoen. Acad.* vol. iv. p. 131) instead of referring the Amboyna plant to *D. sativa*, referred it to his own *D. aculeata*, Linn. (*Sp. Pl.* ed. 1. p. 1033).* from which it differs in having stems which twine to the left instead of the right and in having simple in place of paniculate male spikes. The confusion thus introduced into the conception of *D. aculeata*, Linn., has been closely parallel with that inherent in the conception of *D. sativa*, Linn. Incorporated by Linnaeus in *D. aculeata* in his later writings, we find *Combilium* accepted under that species by Burmann in 1768 (*Flor. Ind.* p. 214 [314]). Dealing with *D. aculeata*, Linn., in

* The name *D. aculeata*, as used in 1753, is based primarily on the citation *Dioscorea foliis cordatis caule aculeato bulbifero* (*Hort. Cliff.* p. 459), and as in 1737 this phrase was applied *only* to the *Kattu-Kelengu* of Rheede (*Hort. Malab.* vol. vii. p. 71, t. 37) the incidence of the name *D. aculeata* is, as Hooker has shown (*Flor. Brit. Ind.* vol. vi. p. 296), definitely limited to the species figured under that name. Unfortunately the identity of the *Kattu-Kelengu* was still doubtful to Hooker in 1892.

1789, we find Lamarck (*Encyc. Meth.* vol. iii. p. 232) providing a description that is strictly confined to the *Combilium* of Rumph. In 1793 Loureiro (*Flor. Cochinchin.* p. 768) supplied an original description of what may very well be a form, as he says, of *Combilium*. Willdenow in 1806 (*Sp. Pl. ed. Willd.* vol. iv. p. 792) included like Burmann both the *D. aculeata*, Linn., of 1753 and the *D. aculeata*, Linn., of 1754. By their citations or their geographical indications, or both, we find that Persoon in 1807 (*Syn.* vol. ii. p. 601) and Sprengel in 1825 (*Syst.* vol. ii. p. 152) did the same. In 1827 Blume (*Enum. Pl. Jav.* p. 23) repeated the treatment of Willdenow and Sprengel, and in 1850 Kunth (*Enum.* vol. v. p. 398), to whom the species remained an altogether doubtful one, which he admitted himself unable to classify, accepted *D. aculeata* exactly as Blume had left it.

In a note following his account of *D. aculeata*, Linn., Kunth calls attention to *D. aculeata*, Roxb. (*Flor. Ind.* vol. iii. p. 800), which Roxburgh had identified with one of the forms of *Combilium*, to the exclusion of Rheede's *Kattu-kelengu*, the latter being regarded by him a wholly doubtful plant. Fortunately in Roxburgh's plant we at last find something definite and tangible.

There are in Bengal two nearly allied Yams which are involved in our enquiry. One is a common crop, so long under cultivation and so long propagated vegetatively that it has lost the habit of flowering. This Yam is known to the inhabitants as the *Susni* or *Sutni-alu*. The other, which is not always cultivated, is nevertheless a common and favourite article of food. This Yam, which is tolerably plentiful, is known as the *Mou-alu*, or *Moa*, a name derived from the Sanskrit term *Madh* (= sweet). The *Mou* and the *Susni* yams are conspecific and the most striking difference between the two is perhaps the fact that whereas the branching roots of the wild plant harden into formidable spines, those of the cultivated one are practically without spines. Early in Roxburgh's botanical career in India he caused figures of each of these plants to be prepared for transmission to the Hon. East India Company, adding the name *D. aculeata* to the figure of the *Susni* Yam and the name *D. spinosa** to that of the *Mou* Yam. These two figures still exist in duplicate, one copy of each being preserved in the Herbarium at Calcutta, the other of each in the Herbarium at Kew. Subsequent study induced Roxburgh to regard the form with roots which develop into spines as the plant named *Combilium* by Rumphius and therefore as *D. aculeata*, Linn. (1754, *not* 1753). The form which had been figured as *D. aculeata*, being now unprovided with a name, was distinguished by Roxburgh as *D. fasciculata*, and both the *Mou* and the *Susni*, with these revised names, were duly recorded in 1814 (*Hort. Beng.* p. 74). When at last in 1832 Carey published the descriptions provided a generation earlier by Roxburgh, the accounts of these two Yams appeared under the names duly issued, nearly twenty years earlier, in the Garden Catalogue

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* When he proposed this name Roxburgh must have been unaware of the fact that Burmann had used it in 1768 (*Hort. Malab. index*, p. 5) for Rheede's *Katu-Nuren-Kelengu*.

(*Flor. Ind. ed. Carey.* vol. iii. p. 800 [*aculeata*]*; p. 801 [*fasciculata*]). The citations under the diagnosis of *D. spinosa* are "Cumbilium. *Rumph. Amb.* v. p. 357. t. 126. One of his varieties thereof is no doubt this very plant; but Katta Kelengu, *Rheed. Mal.* vii. t. 37. is too imperfect a figure to be quoted." This sentence gives the clue to Roxburgh's change of name. When he originally considered the question he only knew the cultivated *Susni* Yam. This he identified with the figure of *Combilium* supplied by Rumphius. Later, somewhere about 1804 (*Hort. Beng.*), he came to know the *Mou* Yam. At first he left *Susni* as *D. aculeata* and used the name *D. spinosa* for *Mou*. On reconsideration, this view became modified. He preferred to identify as *D. aculeata* one of the varieties of *Combilium* described by Rumph rather than that which is the subject of Rumph's plate.

In certain regions, however, the *Mou* as well as the *Susni* is the subject of cultivation. Lamarck's reference to its presence in Réunion, with the not very appropriate name of 'Mozambique Yam,' points to it as cultivated there in 1789. Specimens obtained by Rottler and Koenig in Malabar and Coromandel indicate the same thing in Southern India. We know from Thwaites that it is a cultivated plant in Ceylon. Specimens in the Petrograd herbarium prove its introduction and cultivation in the Loo-choo Archipelago. The same thing is true of Northern India.

Hamilton (then Buchanan), the friend and contemporary of Roxburgh, when engaged in his great economic survey of Bengal between 1807 and 1813, gave close attention to this species and came to conclusions that differ a little from those of Roxburgh. His specimens show that he regarded the *Susni* Yam, from its likeness to the figure which Linnaeus cited from Rumph under the name *D. aculeata*, Linn. (1754, not 1753) as that to which the Linnean name ought perhaps to be restricted; he inclined in fact to what we know, from his manuscript illustration, was Roxburgh's original view. The cultivated form of the *Mou* Yam, however, is that which Hamilton preferred to identify with the *Combilium* to which the main description of Rumph refers; his name for this is accordingly *D. Combilium*, Ham. The uncultivated *Mou*, which Roxburgh originally had figured as *D. spinosa*, Hamilton named *D. echinata*, a sufficient indication that the name *spinosa* had not been used by Roxburgh in the particular copy of the manuscript *Flora Indica* which we know to have been in Hamilton's possession.

There are indications that information had reached India of a desire on the part of certain European botanists to learn precisely what the *D. aculeata* or *Mou-aloo* of the Calcutta garden Catalogue issued in 1814 might be, and to satisfy this desire specimens were secured from one of Roxburgh's actual plants. The label which accompanies one such specimen in the Natural

* Kunth, we have seen, cites this as *D. aculeata*, Roxb., and a reference to the passage shows that the quotation is accurate. But the context suggests that Roxburgh regarded the name as one already in use and a reference to the *Hortus Bengalensis* shows that Roxburgh did not accept responsibility for the name.

History Museum, London, bears the legend, in Wallich's handwriting:—"962 Dioscorea aculeata exclusis forsan synon. Rheed. & Rumph. H. B. C. August 1815." A duplicate of this specimen, now without the original label, is preserved in the Imperial Herbarium, Petrograd. When in 1832 Wallich was engaged in London in the distribution of the Hon. East India Company's herbarium, he appears to have overlooked what Roxburgh had done with regard to the *Mou* and the *Susni* Yams in his *Hortus Bengalensis* and his *Flora Indica*,* and to have forgot his own action of seventeen years before. Amalgamating in his distribution the *Mou* and the *Susni*, as well as other *Dioscoreae*, Wallich employed for his aggregate the name *D. spinosa*, Roxb., used for the *Mou-alu* only and even as regards that particular plant altogether discarded when, quite early in his career, Roxburgh decided that the *Mou* was a form of *Combilium* and was therefore the plant which in 1754 Linnaeus had named *D. aculeata*. The particular form to which Roxburgh did apply the Linnean name agrees so precisely with Rheede's figure of *Mu-kelengu* that the only surprise which those who, profiting by the acumen and sagacity of Hooker in identifying Rheede's plant with the *Combilium* of Rumphius, now experience, is that botanists so judicious as Roxburgh and Hamilton should have failed to observe that the *Mu* of Malabar and the *Mou* of Bengal are the same plant, the linked terms *Kilengu* and *Alu* being exact equivalents.

The name *D. spinosa*, Roxb. ex Wall. (*Cat. Lith.* n. 5103),† was

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* Copies of Carey's edition of Roxburgh's *Flora Indica* had not reached London when this distribution took place. But it should be recollected that the *Flora Indica* of Roxburgh occupies, among works of its kind, the singular position of having been published and in habitual use by botanists many years before it was printed. We have the testimony of Buchanan (afterwards Hamilton) to this effect in a letter dated 11th April, 1797 (*Ann. Roy. Bot. Gard. Calcutta*, vol. x. pars 2, p. x). Moreover the title-sheet to the second part of Roxburgh's *Hortus Bengalensis*, dated 1813, indicates that this part consists of a list of those species described by Roxburgh in his *Flora Indica* which had not then been introduced to the Hon. Company's Garden at Calcutta. Wallich was one of those who owned a manuscript copy of the *Flora Indica*; whether he had it with him in London is not known; other copies were already in England in 1832. The case is one with which the wisdom of systematic students in congress assembled has failed to cope equitably; a knowledge of the facts does, however, induce sympathy with Griffith in the strictures which serve as a preface to his edition of the Cryptogamic portion of Roxburgh's *Flora*, published in 1844.

† The results which attend the necessity of working under pressure are unusually manifest in Wallich's treatment of *D. spinosa*, Roxb. ex Wall. (*Cat. Lith.* n. 5103). The admixture of species under this number is a trifling drawback as compared with the reduction to a mere jumble of synonyms of the orderly and reasoned treatment elaborated by Hamilton. No injustice is done to Roxburgh in this instance because none of the specimens dealt with had been examined by Roxburgh. It seems in this instance worth while to effect the reductions which Wallich's treatment has rendered necessary.

5103. Dioscorea spinosa, *Roxb.* A. *D. Combilium*, H. Ham. Gungachara et Gungachara (*Lith. Cat.*). Corrected by Wallich himself in Herb. Propr. to "Gungachara et Phuranbari." There is no Gungachara specimen. The one present is written up by Hamilton as follows:—D. Combilium. Phuranbari, 9 Feb. 1809. It is the *Mou-alu*, forma culta.

B. *D. hirsuta*, H. Ham. e Gualpara et Monghir. There is no Mongyr

taken up by Hooker who, while rejecting one of the species which Wallich had confused with *Mu-kelengu* and *Combilium*, inadvertently accepted another in which the foliage singularly resembles that of *Mu-kelengu*. This species is nevertheless very distinct and approaches more closely in its essential characters to a Central American species, *D. cymulosa*, Hemsl. (*Biol. Cent. Amer. Bot.* vol. iii. p. 355. t. 90). So great is the resemblance in this case that Hooker has ventured to reduce the American species to his *D. spinosa*. It should be noted that the description of the female raceme and the fruit of *D. spinosa* (*Flor. Brit. Ind.* vol. vi. p. 291) is taken, not from the plant described by Roxburgh, but from the species outwardly resembling Roxburgh's plant confused therewith by Wallich.* This species has been described by the writers in 1904 as *D. birmanica* (*Journ. As. Soc. Beng.* vol. lxxiii. pars 2. p. 185).

The *Mou-alu*, both as a wild and as a cultivated species, is widely spread in India. In Indo-China it is found as a cultivated plant, as it also is in the Mascarenes, Ceylon, the Malayan islands and the southern islands of the Japanese system. In dry Central Burma it is preferred as a crop to the *Susni-alu* owing to the protection against pigs which the spiny roots afford. The *Susni-alu*, in many states, is widely cultivated in India and in

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specimen. The one present is written up by Hamilton as:—D. hirsuta. Goyalpara, 17 Oct. 1808. It is the *Kukur-alu* (*D. anguina*, Roxb.).

C. Moalmyne, 1827. Two specimens both collected by Wallich: one, in fruit, has the field-note "Moalmyn, 8 March, 1827"; the other, a flowering male, has the note "Moalmyn, 11 April, 1827." Both are *D. birmanica*, Prain and Burkill.

? D. *D. aculeata*, H. Ham. e Monghir. Left without correction by Wallich. The specimen is written up by Hamilton as:—D. aculeata? Nathpur, 21 Sep., 1810. The plant is the *Susni-alu* (*D. fasciculata*, Roxb.); Nathpur is in Purnea, not in Mongyr.

? E. *D. echinata*, H. Ham. e Monghir et Gualpara (*Lith. Cat.*). Corrected by Wallich himself in Herb. Propr. to "e Bahadurgung et Borybari." There is no Bahadurganj specimen. The one present is written up by Hamilton as follows:—D. echinata. Borybari, 14 Feb., 1809. It is *Mou-alu*, forma inculta (*D. aculeata*, Roxb., i.e. *D. spinosa*, Roxb. ex Wall.). The locality is in Rangpur, hence the necessity for Wallich's correction noted above.

F. Prome, 1827. One specimen collected by Wallich with field-note "montes prope Prome, 15 Sep., 1826." The plant is *D. birmanica*, Prain and Burkill.

? G. Napalia inferior, 1820. Two specimens, both collected by Wallich in Dec. 1820 and both marked by him 'Cissampelos.' Both are the *Kukur-alu* (*D. anguina*, Roxb.).

H. Sillet, F. D. One specimen from Sylhet, collected by F. da Silva, which is the *Kukur-alu* (*D. anguina*, Roxb.).

* Some minor inadvertencies have incurred in the writing up and the citation of the Wallichian specimens of Cat. 5103 in the *Flora of British India*. Thus 5103A (*D. combilium*, H. Ham.) though cited as 'D. Cernbulium' has been written up as *D. anguina*; while 5103B (*D. hirsuta*, H. Ham.) though written up as *D. anguina*, which it really is, has been cited as *D. spinosa*. The remaining citations under *D. spinosa* and *D. anguina* respectively are in conformity with the specimens, subject to the reservation that 5103C and 5103F, being sheets with specimens which Hooker has accepted on Wallich's authority as *D. spinosa*, but which really belong to the very different *D. birmanica*, are to be excluded from *D. spinosa* and *D. anguina* alike.

Western Malaya. In Malaya east of the Wallace-line and in the Philippines the variety described by Kunth in 1850 as *D. tiliaefolia* is abundant as a wild plant; though conspecific with the *Mou-alu* or *Mu-kelengu* it does not come within the discussion for which the Indian plants call in connection with the incidence of the name *D. sativa*.

The earliest name for the species as a whole is *D. aculeata*, Linn., using that name as it was used by Linnaeus in 1754 (*Amoen. Acad.* vol. iv. p. 131), and this is the name that has come into general use. The verdict of Hooker, that this name cannot be used because this is not the plant to which Linnaeus applied the name *D. aculeata* in 1753 (*Sp. Pl.* ed. 1. p. 1033) is, however, unimpeachable. So long as the position of *D. aculeata*, Linn. (1753), the authority for which is the *Kattu-Kelengu* of Rheede (*Hort. Malab.* vol. vii. p. 71. t. 37), remained doubtful, the continued misuse of the Linnean name was free from inconvenience. Now, however, that it is clear that the species named *D. aculeata* by Linnaeus in 1753 is a member of the section *Enantiophyllum* and is the one described by Hooker in 1892 as *D. Wallichii*, Hook. f. (*Flor. Brit. Ind.* vol. vi. p. 295), it is no longer possible to employ the name *D. aculeata* for the *Mu* of Rheede and the *Combilium* of Rumphius. The oldest name within the genus is that of *D. fasciculata*, Roxb., a usage adopted by one of us in 1903 (*Beng. Pl.* vol. ii. p. 1066). There is however now no room for doubt that the plant described by Loureiro as *Oncus esculentus* (*Flor. Cochinchin.* vol. i. p. 194) in 1793 is the *Mu* Yam. This being so, the dictates governing nomenclature that are now in force demand the use of the new combination *D. esculenta*.*

When we come to consider the last of the six elements included by Linnaeus under *D. sativa* we find ourselves confronted by a more serious difficulty than any with which we have yet had to deal. This element, *D. sativa*, Linn. [1], is the plant figured by Ehret in 1737 (*Hort. Cliff.* t. 28) which, as Hooker and Bentham and Lamarck and Grisebach have all pointed out, must be accepted as the basis of *D. sativa*, Linn. Views as to the identity of this plant have been somewhat varied. The extremes have been that of Lamarck who would not venture to suggest what it is unless it were perchance the plant in cultivation in Paris in 1789 as *D. sativa*, which Lamarck could not distinguish from the species depicted in a figure published by Plukenet that Linnaeus had cited under his *D. villosa;* and that of Bentham who has expressed himself as satisfied that Ehret's plate is an acceptable representation of one of the two species included by Linnaeus under his *D. bulbifera*, to which species, as a consequence of this judgment, the name *D. sativa*, Linn., has by many recent authors been transferred.

When regard is had to the circumstance that Ehret was the artist concerned, we are justified in assuming that the picture represents with some approach to fidelity the object or objects depicted. This being the case it may be said at once that, owing to the disposition of the secondary venation, the leaves in Ehret's

* One of us has communicated this suggestion to Dr. E. D. Merrill, who has formally adopted the name as *D. esculenta*, Burkill (*Interp. Rumph. Herb. Amboyn.* p. 147).

plant are those of some species altogether different from *D. sativa*, Benth. and, owing to the outline of the capsules, the fruit in Ehret's plant is that of a species quite remote from *D. sativa*, Benth. But while it is thus certain that *D. sativa*, Benth. cannot be the species which Linnaeus accepted as the basis of *D. sativa*, Linn., we are not brought nearer to the identity of the Ehret plant.

The suggestion made by Lamarck in 1789 was in essence accepted by Kunth in 1850 and there is no doubt, when examples of *D. villosa*, Linn., are compared with Ehret's plate that, as regards the leaves, that plate may be accepted not only as a good but as a singularly accurate representation of this North American species. The difficulty which the plate then presents resides in the fact that the fruiting spike shows the capsules of a species which we know from experience should contain seeds which are winged at the top only, and that they are in shape, size and appearance wholly unlike the capsules of *D. villosa*, Linn., in which the seeds are winged all round. The two facts mentioned can only be reconciled if we assume that the leaves and the fruit depicted by Ehret were taken from different specimens belonging to different species. That the leaves and the the fruit were in fact derived from different specimens we already know. The plant described by Linnaeus (*Hort. Cliff.* p. 459) had not flowered in 1737; the fruits shown therefore either came from that plant in a later year or belonged to some other plant. An examination of the figure shows that the rachis of the fruiting spike is made to leave the stem nearly but not quite from the axil of the subtending leaf, and that this rachis is made to diverge from the stem at an unnatural angle. It is also noticeable that at the time the fruiting spike was added to the plate a stipulary prickle was added at the base of the subtending petiole but placed at the upper aspect of the petiole instead of at the point where a stipulary prickle would normally be situated. The conclusion, indeed, to which an examination of the plate leads is that both the fruiting spike and the stipulary thorn were added after the main figure was drawn and the style in which these additions to Ehret's figure have been executed induces some suspicion that they may have been the work of another artist. The circumstance to which we have already adverted, that Linnaeus did not refer to the figure of *D. foliis cordatis alternis, caule laevi* in his text and that both Royen in 1740 (*Flor. Leyd. Prodr.* p. 527) and Linnaeus himself in 1747 (*Flor. Zeyl.* p. 170) have avoided the citation of this plate, at least suggests the possibility that there was some doubt in their minds as to the congruity of the foliage and the fruit.

Fortunately the matter no longer remains doubtful. The specimen from which the drawing of the fruiting spike shown in the *Hortus Cliffortianus* figure was made is still available for study in the Natural History Museum collection at South Kensington. It is in fact the Cliffortian specimen which purports to represent the species now under discussion and though it bears no legend in the handwriting of Linnaeus, it had been written up as *D. sativa*, by some early student, before it became the property of the British Museum. The leaves and stem of

this specimen are singularly unlike the leaves and the stem of Ehret's figure and therefore equally unlike those of any specimen of any of the forms of *D. villosa*, Linn. The leaves and stem are, however, exactly those of *D. chondrocarpa*, Griseb. (*Flor. Bras.* vol. iii. p. 34) and the specimen might without hesitation be identified as *D. chondrocarpa* but for the circumstance that none of the leaves present exhibit the stipulary prickles so characteristic of that species. This objection is not wholly insuperable. The specimen, obviously derived from a plant grown under stove conditions, is taken from high up on a branch, and even in wild specimens these prickles towards the ends of the branches tend to become small and at times are absent. Moreover, as we have seen, the artist who added the fruiting spike to Ehret's plate has been at pains to add also a stipulary prickle. This he was not likely to have done had not the presence of such prickles on some part of the plant whence this specimen was derived arrested his attention.

The description of *D. chondrocarpa* provided by Grisebach in 1842 is not the earliest account of this species at our disposal. It is the plant figured by Burmann in 1755 (*Pl. Amer. Plum.* vol. i. p. 73. t. 83) as *China Michuacanensis, sive Smilax aspera minor, Boyaux du Diable*—in Plumier's MSS. named *China Michuanensis, seu phaeo Rechi**; and referred by Burmann (l.c.) to *Smilax caule aculeato, foliis inermibus ovatis retuso-mucronatis*, i.e. to *Smilax Sarsaparilla*, Linn. (*Sp. Pl.* ed. 1. p. 1029). Being a *Dioscorea* and not a *Smilax* it is not *S. Sarsaparilla*, Linn., though we now know from Burchell that it is the plant whose rhizomes yield the genuine 'Salsaparillia' of commerce. Willdenow in 1806 rectified the error into which Burmann had fallen as to the specific identity of this plant, but unfortunately without observing that it is not a *Smilax* but a *Dioscorea*; it appears in his work as *Smilax acuminata* (*Sp. Pl. ed. Willd.* vol. iv. p. 779). The fact that this plant is the source of the true Sarsaparilla affords a possible explanation of its presence in the collection of so ardent a grower of rare and interesting species as the owner of the famous garden at Hartekamp.

A native of Brazil, the reputation of the drug it yields, and the

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* As the description supplied by Burmann is very condensed, and as he has inadvertently referred the plant not only to a species but to a genus to which it does not belong, we take this opportunity to print Plumier's original description in full:—

China michuacanensis seu phaeo Rechi Lib. v. cap. lv.

Huius etiam nec flores nec fructus potui observare curiose licet conquisitos. Ejus radix dura est et compacta radicum arundinacearum instar intus rubens adstringens et amariuscula deforis vero e russo nigricans tuberculis nodosa ac innumeris fibris longis et duris stipata, ex ea sarmenta quaedam proveniunt dimidium digitum fere crassa solida seu dura virentia aculeis ruborum nostratum instar armato altissime tandem super vicinas arbores conscendentia ac ramos quosdam emittentia foliaque quaedam cordata, acumine longo donata, quatuor poltices circiter ampla glabra superius sature inferius vero diluto virentia costulisque septem plantagininis [plantaginis] in morem sustentata.

Pluribus in locis reperitur haec planta apud insulam martinicensem ubi vulgus eam boyaux du Diable appellant eo quod intestineorum [sic] funicolum instar sarmenta ejus frangi contumacissima existant.

Smilacis forte est species.

unfortunate necessity for its employment, sufficiently accounts for the introduction of this species to Guiana and to the Antilles, where it extends from Trinidad, St. Vincent and Martinique to Porto Rico.

In spite of the identity of *Smilax acuminata*, Willd., and *D. chondrocarpa*, Griseb., the latter name was still the one recognised by Uline in 1897 (*Engl. Nat. Pflanzenfam. Nachtr.* II.–IV. p. 84) and although we are aware that the name first used in 1842 cannot be sustained, we do not propose here to suggest the new combination which the identity of these two plants seems to call for, owing to the circumstance that it is not impossible that in the 'Boyaux du Diable' we may have only to deal once again with the *Polygonatum* of Plumier which was in 1789 made by Lamarck the basis of his *D. altissima*. An examination of the two plates published by Burman (*Pl. Amer. Plum.* t. 83 and t. 177. fig. 2) shows that *Smilax acuminata* and *D. altissima* have the same foliage; a comparison of the two descriptions by Plumier shows that they have the same underground stem and the same habit. One very serious difficulty is that in *D. altissima* as figured by Plumier the leaves are opposite. The numerous specimens studied by us show that in *Smilax acuminata* (*D. chondrocarpa*) the leaves occasionally are opposite or nearly so, but they are never so strictly and habitually opposite even on the lower stem as in the case of *D. alata* or *D. cayenensis*, both of these, but especially the latter, being provided with branches, on some of which all the leaves are opposite while on others all are alternate. There is another, and perhaps more serious difficulty; the male flowers of *D. chondrocarpa* have a glabrous perianth, whereas the female flowers of *D. altissima* are described by Plumier as having a pubescent perianth, and until *D. altissima*, Lamk, which has never been met with since Plumier made his drawing and description, can be studied from actual specimens from Martinique, it seems for the moment desirable to leave it an open question as to the identity of *D. chondrocarpa* and *D. altissima*. This uncertainty, however, does not affect the question immediately before us, which is the identity of *D. sativa*, Linn. [1].

Had the Linnean citation of the *Hortus Cliffortianus* in 1753 been identical with the Linnean citation of 1747 (*Flor. Zeyl.* p. 170) and with that of Royen in 1740 (*Flor. Leyd. Prodr.* p. 527); had it been confined to the page (*Hort. Cliff.* p. 459) and therefore to the plant there somewhat inadequately described; we might have been justified in deciding that *D. sativa*, Linn. [1], and *D. villosa*, Linn. (*Sp. Pl.* ed. 1. p. 1033), are conspecific. The question for settlement then would have been which of the two names, simultaneously published by him for the same species, it is desirable to retain; which of the two it is necessary to discard. But in 1753 Linnaeus, with less caution than he had hitherto displayed, cited not only the page with his own text but the plate with Ehret's figure, under *D. sativa*, Linn. (*Sp. Pl.* ed. 1. p. 1033); the figure in question becomes, as a consequence, at least some part of the authority for his species; as the figure is a composite one, the "species" is, even at its inception, not a natural species, and the name *D. sativa* is without a definite basis. The judgment of

Lamarck in 1789 had a firmer foundation even than that author imagined, and the name *D. Cliffortiana*, Lamk, also disappears.

Our endeavour to answer the question "What is *D. sativa*, Linn.?" has led us into unexpected bye-paths and has produced some unexpected results. A brief summary of these results may not be without interest.

Two authors who have used the name—Sieber in 1821 and Bowdich in 1825—have applied the name to individual species which do not belong to the genus *Dioscorea*.

Eight authors—Thunberg in 1784, Rodschied in 1796, Presl in 1827, Bunge in 1831, Wallich in 1832, Grisebach in 1842, Bentham in 1861, Miquel in 1865—have applied the name *D. sativa* to species other than any of those included under the name by Linnaeus. At least two of these—Grisebach and Bentham—were aware that the Linnean *D. sativa*, so far as citation is concerned, covers several different species.

Other authors, however, have been alive to this fact. Gaertner in 1788 implied the exclusion of a West Indian plant cited by Linnaeus from Sloane; Willdenow in 1806 expressly excluded another West Indian plant cited by Linnaeus from Plumier; Meyer in 1818 excluded an Amboyna plant cited by Linnaeus from Rumph; Presl in 1827 excluded both the West Indian plant from Plumier and the Amboyna plant from Rumph. Maycock in 1830 by citation excluded everything save the unarmed condition of the West Indian cultivated Yam taken up by Linnaeus from Sloane; Dillwyn, in 1839, in practice excluded everything except one of Rheede's Malabar Dioscoreas. Kunth in 1850 excluded, in intention, everything save a Ceylon plant taken up by Linnaeus from Hermann and a Malabar plant taken up from Rheede. Thwaites in 1864 excluded everything save Rheede's Malabar plant, and was followed in this by Hasskarl in 1867.

Four authors—Lamarck in 1789, Grisebach in 1842, Bentham in 1861, Hooker in 1892—have expressed the conviction that the subject of Ehret's plate (*Hort. Cliff.* t. 28) must be regarded as the authority of Linnaeus for the species *D. sativa*, Linn. (*Sp. Pl.* ed. 1. p. 1033). It is significant that three of these authors—Grisebach, Bentham, Hooker—have used the name for species of *Dioscorea* which Linnaeus never did include in *D. sativa*, and that Lamarck, who did confine himself strictly to the subject of Ehret's plate, admitted his inability to identify the species there depicted.

Lamarck in 1789 thought it desirable to suppress the name *D. sativa* and to use instead the name *D. Cliffortiana*. In this Lamarck has been followed only by Poiret in 1823 and by Kunth in 1850. It is again significant that Poiret applied the name *D. Cliffortiana* in connection with a plate (*Lamk. Ill.* t. 818) on which are shown two species which Lamarck had excluded from *D. Cliffortiana* and that Kunth still confessed his inability to recognise Ehret's plant.

Turning now to the components of *D. sativa*, Linn., as indicated by the citations of Linaeus we find that two of these are not members of the genus *Dioscorea;* the others do belong to the genus.

The Amboyna plant cited from Rumph is *Cardiopteris Rumphii*, Baill. (*Adansonia*, vol. x. p. 280), by some authors regarded as no more than a form of *Cardiopteris lobata*, R. Br. (*Wall. Cat. lith.* 8033A);

The Ceylon plant cited from Hermann is *Tinospora cordifolia*, Miers;

The West India plant cited from Plumier is *Discorea martinicensis*, Spreng.;

The West Indian plant cited from Sloane is *D. cayenensis*, Lamk;

The Malabar plant cited from Rheede is *D. esculeata*, Burkill (*Oncus esculentus*, Lour.); finally,

The figure by Ehret (*Hort. Cliff.* t. 28) regarded by Lamarck, Grisebach, Bentham, and Hooker as the authority for *D. sativa*, Linn., is certainly composed of a combination of two different species. One of these, which is referred to in the accompanying text (*Hort. Cliff.* p. 459), is *D. villosa*, Linn.; the other, to which the text makes no allusion, is *D. chondrocarpa*, Griseb. (*Smilax acuminata*, Willd.).

There is no room for doubt that when he used the name *D. sativa* it was the intention of Linnaeus to so designate one of the species of *Dioscorea* cultivated as an article of food. If this intention be taken into account it is manifest that we must exclude from consideration all the elements of his aggregate except *D. sativa* [3], which is the *Mu-kelengu* of Rheede from the East Indies, and *D. sativa* [4] which is the *Volubilis nigra, folio cordato nervoso* of Sloane. As these two are distinct species, belonging respectively to the very different sections *Combilium* and *Enantiophyllum*, the name cannot be applied to both. In 1737, 1747 and 1753 Linnaeus cited the East Indian edible and cultivated plant, the 'Lesser Yam' of India, before citing the 'Negro Yam' of the West Indies. Blume, Dillwyn, Kunth and Thwaites were therefore, from this particular standpoint, justified in recommending the restriction of the name *D. sativa* to the Lesser Yam, the more especially since Linnaeus had refrained both in 1737 and in 1747 from citing the figure by Ehret as a figure of his species. But by his citation, in 1753, when he first proposed the epithet 'sativa,' of the figure in question as the basis of his species, Linnaeus defeated in advance the intention these authors had in view. As Hooker has stated (*Flor. Brit. Ind.* vol. vi. p. 291) "the plant figured in 'Hortus Cliffortianus' must be accepted as *sativa*, Linn." Since the plant so figured is a chimaera, the original portion of which represents the stem and leaves of a species (*D. villosa*) which Linnaeus himself named and characterised in 1753, that is not a cultivated edible *Dioscorea*, while the added fruiting spike and prickle belong to another species with medicinal properties, the name *D. sativa* becomes one that cannot be used.

XXVI.—GUNNERA MANICATA AND G. BRASILIENSIS.

O. Stapf.

Dr. A. K. Schindler in his monograph of the *Halorrhagaceae* (completed by Prof. C. Mez; in Engl. Pflanzenreich, iv. 1905, 225) has two "*Gunnera manicata*, Lind." One (p. 122) is "*G. manicata*, Linden in Illustr. hortic. xx. (1873) 156 nec alibi," the other (p. 124) "*G. manicata*, Linden in Belg. Hortic. (1867) 104 (nec alibi, nomen nudum)." The former is retained as a distinct species, stated to have been introduced by Linden from Colombia, without precise indication of locality and to have been seen by the author in the Herbaria of Munich and Petersburg; the latter is made the basis of a new species, *G. brasiliensis*, Schindler, including *G. manicata* of Schwacke in Engler's Bot. Jahrb. xii. (1890) Beibl. 28, p. 1, and of Petersen in Engl. & Prantl, Pflanzenfam. iii. 7 (1893), 236, fig. 107. The distribution of this species is given as follows: "Brasilien. Rio de Janeiro, an Felsen am Abhang der Serra do Oratorio (Ule n. 1229, im März fruchtend," to which the author adds that he saw the plant in the Berlin Herbarium. As *G. manicata* is one of our noblest and most decorative foliage plants for water borders and lawns it seems to be worth while to inquire into the claims of the conflicting names.

It was Joseph Libon, a Belgian collector, who discovered the plant known in British gardens as *G. manicata*. He travelled for Jean Linden in Brazil between 1859 and 1861 when he died at Rio de Janeiro. Most of his work was done in the State of Santa Catharina which he explored from Desterro (Florianopolis) to beyond the watershed of the Serra do Mar. Here on the western side of the Serra do Mar, in the open grassy highland which stretches towards Lages (987 m.)—the Campos de Lages—the Gunnera was found growing in "régions froides et glacées . . . . dans les parties marécageuses au pied des premiers contreforts de la Serra do Mar," "glacées" meaning evidently not more than that snow and frosts occur. Linden advertised the plant as *G. manicata*, Lind. in his Prix-Courrant for 1867 and in Belgique Horticole, vol. xvii. p. 104 of the same year. No description was given in this place beyond the statement that each leaf attains to a circumference of 5 m. But about the same time Delchevalerie, Chef multiplicateur au fleuriste de la ville de Paris, gave a descriptive account (in Revue Horticole, 1867, 218) of the plant, a specimen of which was then to be seen in the International Horticultural Exhibition at Paris. This specimen had flowered with Linden the year before. Linden as well as Delchevalerie attribute the discovery of the plant to Libon and give the Serra do Mar as its home, a statement which Linden insisted upon when in 1875 he introduced another new Gunnera, this time from Colombia (Linden, Prix Courrant, f. 1875, p. 5). Meanwhile E. André had published a fuller description of *Gunnera manicata*, Linden, in Illustration Horticole, xx. (1873) 156, with the remark "Voici la description de cette magnifique espèce introduite par M. J. Linden, de la

Nouvelle-Grenade. . . . ." This reference to New Granada or Colombia was evidently a slip of the pen, as is evident from his observation that Linden had introduced it about ten years ago (about 1863) and his reference to the establishment de la Muette where we know from other evidence the South Brazilian plant had by then been in cultivation for several years. A coloured figure of a barren specimen of *Gunnera manicata* appeared in Illustration Horticole, xxx. (1884) 128, t. 531, and another description of the species by J. G. Baker in the Gardeners' Chronicle for the 3rd July 1886 (ser. iii. vol. xxvi. p. 8). So far all our knowledge was based on the plant introduced from the Campos de Lages; but in 1890 Schwacke published a paper on *G. manicata* (in Engl. Bot. Jahrb. Bot. 28, pp. 1–3), in which he amplified the earlier descriptions of the species from some fruiting material collected by Ule in the Serra do Oratorio, 700–1200 m., and from notes and drawings received from Fritz Müller in Blumenau, Santa Catharina. The Serra do Oratorio is part of the Serra do Mar, immediately south of the Serra de Trombuda which Libon must have crossed on his way from the Rio Trombuda to Lages, if indeed he did not himself pass the Serra do Oratorio on his way back from Lages to Laguna. Thus Libon's and Ule's localities are either identical or in very close proximity. Where exactly Fritz Müller made his observations on *G. manicata* is not known, but his home being at Blumenau the Serra do Mar was easily within his reach. It is therefore evident that the area of *G. manicata* as known up to the date of Schwacke's paper, that is 1890, was limited to a portion of the Serra do Mar of Santa Catharina, situated between 700 and 1200 m. This area possesses a typically mild-temperate climate with occasional snowfall and frost during the winter and an annual rainfall (1250–2000 mm.) very like that of Western Great Britain, a fact which explains the perfect development of this majestic herb in certain parts of this country.

In Germany *G. manicata* is less at home; but fine specimens have been grown in the Botanic Garden of the University of Erlangen, Bavaria. These provided the material for two valuable papers on its external and internal morphology, namely Berckholtz's Beiträge zur Kenntniss der Morphologie und Anatomie von *Gunnera manicata*, Lind. (9 plat.) in Bibliotheca Botanica, v. Heft. 24 (1891), and Jonas, Über die Inflorescenz und Blüte von *Gunnera manicata*, Lind., Jnaug. Diss. Erlangen 1892. Neither seems to have been consulted by the authors of the monograph of the *Halorrhagaceæ* in the Pflanzenreich.

From the account given above it is clear that there is no basis for a Colombian *G. manicata* as distinct from a Brazilian species of the same name and consequently for the renaming and the assumption of a tropical habitat for the latter. Thus *G. brasiliensis* becomes a mere synonym of *G. manicata* which should be attributed to Linden ex Delchevalerie or Linden ex E. André. This contention might appear to be challenged by the treatment which the two supposed species experienced in the key of the species of Gunnera in Schindler-Mez's monograph. There "*G. manicata*" (i.e. the Colombian plant) is grouped with the species possessing "ramuli fructiferi gracillimi haud incrassati,"

and *G. brasiliensis* with those having "ramuli fructiferi crassi, carnose aucti." The branches of the inflorescence of *G. manicata* as understood here are slender when in flower and shrink considerably when dried, and might be described as "graciles" or even "gracillimi." They become thickened only on attaining to maturity, when they may measure up to 8 (rarely 10) mm. in diameter, that is less than those of *G. chilensis*. As the monographer says of his *Gunnera manicata* "Fructus ignotus," it is evident that the "ramuli fructiferi" which he described as "haud incrassati" and in the key, and only there, as "gracillimi" were not mature.

It may be added that Fritz Müller in a letter to Darwin preserved in the Herbarium at Kew, received in October, 1875, writes: "Lately I had an opportunity of examining the flowers of a very stately species of *Gunnera* (the gigantic leaves not springing from the ground, but from the tips of an erect palm-like stem, about 4 met. high) . . . . " Overleaf there are drawings of the flowers of this *Gunnera* exactly like those which he sent to Schwacke (*see above*) and written up as "*Gunnera* (*manicata*?)." The formation of an aerial stem of such dimensions in *G. manicata* is very remarkable, and probably exceptional; but it may be pointed out that Nicholson in his Dictionary of Gardening, ii. 103, fig. 157, figures a specimen of *Gunnera scabra* with an ascending aerial stem which to judge from the dimensions of the leaves might have been well up to 1 m. high.

XXVII.—MISCELLANEOUS NOTES.

James William Helenus Trail.—The death of Professor J. W. H. Trail, M.D., F.R.S., on 18th September, 1919, in a nursing home at Aberdeen, has deprived Kew of a very devoted friend and valued correspondent. The son of the Rev. Dr. Samuel Trail, he was born at Birsay in Orkney, where his father was parish minister, on 4th March, 1851. After a sound preliminary education at home, Trail was sent to the Grammar School, Old Aberdeen, and having passed through the various classes there, proceeded to the University in 1866. The taste for natural history studies, already marked during his school days, became accentuated in the course of his undergraduate career, and resulted in his obtaining his master's degree in 1870, with honours in natural science. Entering the medical faculty his academic record there was equally distinguished, though this did not deter him from laying aside his professional studies in autumn, 1873, in order to take advantage of an opportunity which had offered itself to him of joining, as botanist, an expedition to Brazil, organised by the Amazon Steam Navigation Company. Returning from this journey, which extended over 16,000 miles on the river Amazon and its tributaries, in 1875, Trail resumed his medical studies and graduated as M.B., in the following year, with highest academical honours.

The value and character of the collections, both zoological and botanical, obtained by Trail during his Amazon expedition, and the ability and thoroughness with which he proceeded to work

them out, attracted immediate attention on the part of those competent to judge. As a consequence he was selected, towards the end of 1876, to fill the post of Government Botanist in British Guiana. But before the date fixed for his departure to take up his new duties, the late Professor G. Dickie, M.D., F.R.S., then Professor of Botany at Aberdeen, was compelled, through failing health, to relinquish his chair. Trail was appointed by the Crown to fill the vacant post. He entered on his duties as Professor at the opening of the summer session of 1877, shortly after his twenty-sixth birthday. Having fulfilled them with singular efficiency and distinction for forty-two years he has now died in harness, to the sorrow of his many friends, in his sixty-ninth year.

The appended list of contributions by Trail to natural knowledge at first sight suggests that early in his career he was more addicted to zoological than to botanical observation, though the fact that as early as 1871 he was giving close attention to galls, on which he was to acquire a reputation that is European rather than merely British, should in itself prevent a conclusion so superficial. The fact that on his return from the expedition to South America he at once took a distinguished place as a descriptive botanist and became an authority on a family so difficult as the Palms, shows that if he had till then published few botanical notes this was not because botanical questions had been neglected. If the same evidence suggests an altered outlook after his appointment to a botanical chair the inference is equally without foundation. Doubtless duty now prescribed the devotion of a very scanty leisure to the publication of botanical rather than zoological observations. But his living interest in the whole field of natural history never abated; throughout his career he was as alert to zoological as to botanical facts and phenomena; the range of his knowledge was as wide, the precision of his observation was as marked in the one field of natural history or the other. One of the chief sources of the authority with which he could speak and of the respect with which he was listened to lay in his intimate acquaintance at first hand with the characters, the habits and the interrelationships of all living things that came within the scope of his observation. How fully he had mastered both subjects and with what ease he could pass from one to the other may be appreciated from the circumstance that when in 1878 the Natural History chair at Aberdeen fell vacant, Trail for a whole year conducted the class of zoology as well as that of botany to the satisfaction alike of the students and of his colleagues, until the new teacher was in a position to take up his duties.

Yet Trail's published notes and papers, numerous as they are, hardly represent a tithe of the vast store of observed facts, freely at the disposal of all who might seek information from him, which his friends have wished, and now wish more than ever, to see placed on permanent record. This inhibition of output, so deeply to be regretted, was a consequence of Trail's high sense of duty. When he began botanical teaching at Aberdeen, the equipment of his department, through no fault on the part of his distinguished predecessor and through no want of sympathy on

the part of the University authorities, was exiguous to a degree. With a courage that nothing could depress and a tenacity of purpose that was irresistible Trail was able by degrees to build up a thoroughly equipped and modern botanical school with a fine teaching museum, well furnished laboratories and an excellent botanical garden. Fortunately for them, unfortunately for his botanical colleagues elsewhere, his University, which never had a more loyal son, recognised and availed herself freely of the business aptitude so manifest in the organisation of his own department. He took an active share from the outset of his teaching career in the Volunteer movement, and with his accustomed thoroughness made himself an efficient Artillery officer, reaching the rank of Major in the University battery. In his later years he was a useful member of the Officers' Training Corps Committee. From 1891 onwards Trail was elected, year by year, Curator of the University library and Chairman of the Library Committee. In the following year he was appointed Dean of the newly established faculty of science. He took a leading part in securing the establishment of a forestry lectureship and in developing the activities of an agricultural department. His many personal gifts to the University include the endowment in 1907 of an Helen Scott Fund, in memory of his mother, daughter of Dr. Hercules Scott, Professor of Moral Philosophy, King's College, Aberdeen, for the benefit of students in any faculty who may display proved ability in the study of botany or zoology. After completing a quarter of a century's service to the University Library, Trail endowed yet another fund, the income of which is to be used, in supplement to the grants from University revenues, in providing works relating to natural science.

The inroads on Trail's leisure were not confined to the business of his University. His help was eagerly sought by organisations outside its walls. When the object was the advancement of education, especially scientific education, his sense of citizenship often impelled him to respond to these appeals. He presided over the Aberdeen Secondary Education Committee and was a Governor of the Aberdeen Endowment Trust, the Dick Bequest and the Robert Gordon Technical College. His interest in the diffusion of natural knowledge in other ways was equally practical. In 1886 he became president, on its foundation, of the Aberdeen Working Men's Natural History and Scientific Society, an active organisation whose excursions he often led. His care for its welfare may best be assessed by the circumstance that its members reappointed him to their chair at every anniversary. Equally effective was his interest in the Buchan Field Club, over which he presided in 1903. He was long editor of the 'Scottish Naturalist,' and afterwards became botanical editor of the 'Annals of Scottish Natural History.'

The Linnean Society of London enrolled Trail among its fellows on 2nd December, 1875, when he returned from his journeys in Brazil. His regard for the welfare of the Society was second only to that shown in the case of his University. It was manifested in many practical ways, one of the most tangible of these being his endowment of a quinquennial award and medal for special research, first conferred in 1910. He was elected a

fellow of the Royal Society in 1893, and presided over the Botanical section of the British Association at the eightieth meeting, held in 1910.

His thoughtful interest in Kew, where his annual visits, up to the outbreak of the late war, were looked forward to by all the staff, was manifested in many ways. A warm comradeship, the outcome of their kindred interests, subsisted between him and the late gifted Curator, Mr. George Nicholson, whose failing health and all too early death caused Trail keen distress. At the request of Sir William Thiselton-Dyer, Trail supplied the general account of the galls observed at Kew for the volume devoted to the 'Wild Fauna and Flora' of the gardens, issued in 1906 (K.B. Add. ser. v. p. 41–46). In 1908 he favoured the museum with an account of the methods successfully adopted by him in the preservation of green colours in botanical specimens exposed to light (K.B. 1908, pp. 49–52).

Far more, to those who enjoyed the privilege of Trail's friendship, than what he had done, was what he was. Whether in lecture-room or laboratory, among the contents of a museum or under the open sky, it was the fine nature of the man rather than his wide knowledge that most impressed and influenced those in his company. Writers more polished, speakers more eloquent there have been. But no one ever was more accurate in statement, more careful in reasoning, more kindly in judgment. His memory will long remain green and nowhere can it remain greener than at Kew. D. P.

The Publications of Professor J. W. H. Trail.

1870.—Note on the food plants of *Acronycta Menyanthidis*. Entom. Monthly Mag. vii, 1870–71, p. 88.

Note on the Lepidoptera of Braemar. Entom. Monthly Mag. vii, 1870–71, pp. 113–114.

Scottish galls. Scot. Nat. 1871–72, pp. 123–125, 156–159, 192–197, 234–235.

On light as an attraction for moths. Scot. Nat. 1871–72, pp. 212–213.

Crambus Myellus in Aberdeenshire. Scot. Nat. 1871–72, pp. 117–118.

Revised variety of *Helix memoralis*, Linn. var. *hortensis*. Scot. Nat. 1871–72, p. 155.

The Greenland shark. Scot. Nat. 1871–72, pp. 48–49.

Albino wild duck. Scot. Nat. 1871–72, p. 269.

Captures of Lepidoptera near Aberdeen in 1871. Entom. Monthly Mag. ix, 1872–73, pp. 42–44.

Scottish galls. Scot. Nat. 1873–74, pp. 30–32, 78–80, 126–128, 170–173, 251–254, 301–305.

Note on the presence of five toes on each leg of a blackheaded gull (*Larus ridibundus*). Scot. Nat. 1873–74, p. 11.

Additions to the Aberdeenshire fauna (1872). Scot. Nat. 1873–74, p. 20.

Captures of spiders in Scotland during 1872. Scot. Nat. 1873–74, pp. 23–25.

Occurrence of the *Echinorhynchus spinosus* on the Aberdeenshire coast. Scot. Nat. 1873–74, pp. 155–156.

Lepidoptera of Sutherland. Scot. Nat. 1873–74, p. 163.

Scottish spiders. Scot. Nat. 1873–74, p. 300.

Helix ericetorum in Sutherland. Scot. Nat. 1873–74, p. 163.

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William Gilson Farlow.—Professor W. G. Farlow passed away on June 3rd, after an illness of three weeks. In him America has lost one of the most eminent of her modern cryptogamic botanists, and mycologists generally deeply regret the passing of yet another of the older systematists, whose work was founded on a thorough all-round knowledge of the lower plants.

Professor Farlow was born in Boston on December 17th, 1844. He graduated in medicine from Harvard, and in 1870 was asked by Professor Asa Gray to become his assistant at Harvard and to undertake especially the work of instruction in the cryptogams, which up to then had been on a very small scale. Farlow

accepted the post, but soon realised that his equipment for the task was insufficient. Finding it impossible to get an adequate knowledge of the subject in America he came to Europe and studied for two years in France and Germany. He worked under De Bary at Strasburg and there no doubt acquired the taste for mycology, to which the greater part of his life was devoted. His earlier papers, however, were on Algae and Pteridophyta, and the most noteworthy of them is that on "An asexual growth from the prothallus of Pteris serulata," in which he described for the first time the phenomenon of apogamy in ferns.

After his return from Europe, he became in 1874 Assistant Professor of Botany at Harvard, and was stationed at the Bussey Institution, the Agricultural School of the University. There his studies of fungi were naturally directed towards those of economic importance, and various articles on plant diseases, such as Potato Rot, Black Knot, Onion Smut, etc. appeared in the Bulletin of the Institution and in the reports of the Massachusetts Board of Agriculture.

In 1879, Farlow was appointed Professor of Cryptogamic Botany at Harvard, which post he held for about 40 years. He now devoted himself more especially to the systematic study of fungi, but although he published little on other cryptogams he did not neglect them, and continued to add to his knowledge. Of marine algae, for instance, he had such a thorough grasp that he could generally refer a specimen submitted to him to its correct genus, and would frequently make a good guess as to the species.

It is as a systematic mycologist, however, that he is best known. Up to the year 1910 he published numerous papers on fungi—critical, monographic and floristic. In the course of his work he compiled a card index of American mycological literature, which formed the basis of the "Provisional Host-Index of the Fungi of the United States," in which he was assisted by Mr. A. B. Seymour, and the "Bibliographical Index of North American Fungi." Publication of the latter was undertaken by the Carnegie Institution of Washington, but unfortunately only the first part appeared in 1905. It is to be hoped that the rest of the work will eventually be made available for reference.

Farlow's opinion on matters of nomenclature was held in high esteem. Together with Professor G. F. Atkinson, he represented the United States at the International Congress held at Brussels in 1910.

In view of some recent controversies with regard to physiological specialisation in fungi, his address, as Chairman of Section G, Botany, of the American Association for the Advancement of Science, 1898, on "The Conception of Species as affected by recent investigations on Fungi," deserves the notice both of systematists and physiologists for its sane outlook.

Among the many honours received by Professor Farlow were the degrees of LL.D. of Harvard, Glasgow, and Wisconsin, and Ph.D. of Upsala. He was a member of the National Academy of Sciences and of the American Philosophical Society, and was President of the American Association for the Advancement of Science in 1906. He was a Foreign Member of the Linnean

Society of London and a Correspondent of the Académie des Sciences, Institut de France. For the first twenty years of its existence he acted as co-editor of the Annals of Botany.

Within the past two years America has lost three of her most prominent systematic mycologists, in the persons of Peck (July, 11th, 1917), Atkinson (November 4th, 1918), and Farlow (June 3rd, 1919). E. M. W.

Mrs. M. A. Sargent.—We record with great regret the death of Mrs. Mary Allen Sargent, wife of Professor C. S. Sargent, of the Arnold Arboretum. Botanical science has suffered a great loss in Mrs. Sargent's death, for, like her husband, she had a great love of nature, and did much for the study of arboriculture. Her keen interest in the subject led her to accompany the Professor on many of his botanical expeditions, and in their travels she made careful studies and drawings of the trees they collected. Her skill as a painter of the trees of North America will keep her in remembrance outside the circle of those whose privilege it was to have experienced her warm-hearted welcome, for the collection of water-colour drawings of trees, made between 1880 and 1890, is now a much valued exhibit in the Museum of Natural History, New York. This fine collection comprises some 400 paintings, which possess an artistic merit which equals their educational interest.

One-leaved Ash (*Fraxinus excelsior* var. *heterophylla*) **from Seed.**—It is interesting to know how far abnormal forms of trees come true from seed. Nurserymen generally propagate such forms by grafting, but it would be an obvious advantage if they could be obtained on their own roots, especially from seeds, because seedling trees on the whole are more satisfactory than grafted ones, or even than those raised from cuttings. Seeds of Irish yew have been sown at Kew but the results have not been good, as nearly all the seedlings have proved to be reversions to common yew. This, of course, is to a great extent to be expected, because the Irish yew is a female tree, and its seeds must necessarily be the result of pollination by some tree not fastigiate in habit. The true Lombardy poplar again, being a male, cannot reproduce itself from seed, yet several hybrid poplars—amongst them *Populus Eugenei* and *P. berolinensis*—are believed to owe their pollen parentage to it, and from it to have inherited their comparatively slender, columnar shape.

Henry records that of several hundreds of acorns of the cypress oak (*Quercus pedunculata* var. *fastigiata*) sown at White Knights, only five came true, but that thirty acorns sown at Nancy produced twelve seedlings true to type. The sub-variety of the cypress oak known as *Grangei*, of which there are examples at Kew, apparently represents a partial reversion to typical *Q. pedunculata*, as the trees are broadly pyramidal in shape, not columnar. Seeds of purple beech are well known to produce a variable percentage true.

The one-leaved ash differs from all the preceding in that its abnormality lies, not in habit nor in colour of leaf, but in the leaves being simple and consisting of one large, ovate blade instead of the normal pinnate arrangement of nine to fifteen much smaller leaflets seen in the common ash. Some seeds sent to Kew from Barton Court, near Canterbury, were sown in 1916. Of the sixty-nine plants raised, thirty-three are true *heterophylla*, the other thirty-six ordinary pinnate-leaved *Fraxinus excelsior*. Several plants show an intermediate state such as is represented by the sub-variety *heterophylla laciniata*, and have, like that tree, leaves composed of three, or sometimes only two, leaflets. No leaf, however, is to be found intermediate in number of leaflets between the trifoliolate and common pinnate arrangements.

The result of the experiment is to show that a sufficient stock of one-leaved ashes can be got on their own roots with little trouble by means of seeds. W. J. B.

Spartina Townsendii at Clevedon, Somerset.—A report on the conditions of the Spartina plantings at Clevedon (see *Kew Bull.* 1918, pp. 26–31, with map on p. 29), as they presented themselves about the middle of September of the present year, has been received from Miss Ida M. Roper. It appears from this report that the Spartina growth in the north-eastern section, that is, towards the river Kenn, has increased in a marked degree and that the outer strip of grass has completely joined together for considerable lengths; but there are still gaps 1-6 yards wide through which the tides rush in, denuding to some extent the surface behind. Yet even there miniature Spartina meadows have been formed from 5-10 yards wide and 40 yards long, so that there is a reasonable prospect of the inner mud shore becoming eventually completely covered over with Spartina. Further on, at B of the map, where the breaches in the sea bank occur, no Spartina has been able to maintain a footing, and the conditions here are as threatening as before. Beyond this gap, outside the three small bights, the Spartina has been able to hold its own in the first half, but suffered much by washing away in the other half, that is towards the Yeo River, All along this stretch the conditions for Spartina growth appear to be not very favourable to judge from the general lack of vigour. It is suggested that closer planting from the start or successive additions in the intervals between the original clumps might save many plants and accelerate their closing up. It should be pointed out that the description of the scale on the map quoted above should read 4 inch = 1 mile, but the map has been reduced a little in reproduction. O. S.

Cuscuta suaveolens, Ser. (*C. racemosa*, Mart., var. *chiliana*, Engelm).—In the Journal of Botany, vol. 46, p. 241 (1908), Dr. W. B. Hemsley published a paper dealing with the occurrence in Britain of three alien species of *Cuscuta*. One of these,

Cuscuta suaveolens, Ser., has recently appeared in considerable quantity on cultivated crops in South Wales. Onions and carrots were the plants chiefly affected but the parasite seems almost indifferent to the nature of its hosts for it had spread on to various weeds, including *Lotus corniculatus*, *Arenaria serpyllifolia*, *Trifolium repens*, *Pastinaca sativa*, and several grasses.

The plant is a native of Chile but has been recorded from various localities in Britain. It seems generally to have occurred on lucerne, or at least in lucerne fields. In continental Europe it has been recorded (under different names) from many localities. The synonymy is complicated but is given in full in the paper quoted above.

The seed from which the onions and carrots were grown in South Wales was apparently obtained from several different sources, mostly from well-known British firms. The dodder may have been introduced with seeds of a previous crop, either directly from Chile or from a European source.

Another alien dodder, *Cuscuta Tinei*, Insenga, has been recorded from South Wales. It occurred on experimental clover plots at St. Fagan's, Cardiff. In this case the crop was raised from Styrian or Bohemian seed. Quite recently it has been received from Worcestershire growing on a crop of onions in an allotment. *C. Tinei* is also probably of American origin and only a colonist or casual in Europe. W. B. T.

Botanical Magazine.—The following plants are figured in the number for July, August and September:—*Kochia scoparia*, Schrad. forma *trichophila*, Schinz & Thell. (t. 8808), a cultivated form of *K. scoparia* of temperate Asia and Europe; *Odontoglossum cristatum*, Lindl. (t. 8809), from Ecuador; *Abelia longituba*, Rehder (t. 8810), a native of Hupeh, China; *Wistaria venusta*, Rehder & E. H. Wils. (t. 8811), from Japan; *Iris Reichenbachii*, Heuffel (p. 8812), a native of the Balkan Countries and South Macedonia; *Delphinium Pylsowii*, Maxim. (t. 8813), from Western China; *Mesembryanthemum nobile*, Haw. (t. 8814), from South Africa; *Rhododendron dichroanthum*, Diels (t. 8815), a native of Yunnan; *Primula chionantha*, Balf. f. & Forrest (t. 8816), also from Yunnan; *Brachystelma foetidum*, Schlechter (t. 1817), from South Africa; and *Crataegus Wattiana*, Hemsl. & Lace (t. 8818), a native of Baluchistan and Central Asia.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 10] [1919

XXVIII.—THE NEW FLAGSTAFF AT KEW.

(With Plates.)

The long-awaited erection of the new flagstaff was successfully accomplished on October 18th last, the mast reaching the vertical position at 3 p.m. The hoisting had commenced early on the morning of the previous day.

For more than fifty years—that is to say from 1861 to 1913—a conspicuous landmark in Kew had been a flagstaff of Douglas fir standing on the mound south of the Berberis Dell. It was given to the Gardens by Mr. Edward Stamp, an importer of American timber, and was 159 ft. high, being of course in one piece. Its age was calculated to be 250 years, its height as it stood in the forest 180 ft., and its weight, after shaping, 4½ tons.

It may be recorded that another flagstaff of smaller dimensions had been presented to Kew by Mr. Stamp in 1859. But ill-fortune pursued this specimen. As it was being towed up the Thames, towards Kew, it was cut in two by a tug. The pieces were afterwards spliced together and safely transported to the appointed site in Kew, but its erection was entrusted to people who were evidently inexpert at such work. As it was in process of being hoisted, a violent gust of wind blew over the pole, apparatus and all, which came crashing to the ground, with the result that Mr. Stamp's gift lay there broken into three pieces. Kew, however, rather gained than lost by this mishap, for the new pole presented by Mr. Stamp was a larger and better sample. In the hands of professional mast-riggers from Deptford Dockyard this was successfully erected in 1861, and there it stood for thirty-five years. In 1895, however, it was seen to be decayed at the base and on being examined by Admiralty officials was reported by them to be unsafe. In the opinion of experts it was still possible to preserve it by removing the decayed base and splicing on a new one. This was done by Messrs. Robinson and Dodd, of Poplar, who lowered it, did the repairs, and re-hoisted it on February 4th, 1896. The new base of the pole was of pitch pine, and of sufficient length to retain the flagstaff at its original height.

These repairs gave the pole a renewed term of existence, but in

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1913 the workmen engaged in giving it its periodical coat of varnish reported that in many parts dry rot had set in and that it could no longer be considered safe. It was, in consequence, taken down, when it was seen to be so badly decayed that further repair was out of the question. And so came to an end the flagstaff of 1861, up to then the finest of its kind in Europe.

The flagstaff had not long been lying on the ground when the following letter was received by the Director from Mr. J. H. Turner, Agent-General for British Columbia. This and the three following letters form the opening pages of the history of the new flagstaff, and it is of considerable interest that Mr. Turner knew Mr. Stamp, and was in British Columbia when the first flagstaff was sent over.

Office of the Agent-General for British Columbia,
17th December, 1913.

Lt.-Col. Sir D. Prain, C.M.G.

Dear Sir,

The British Columbia Flagstaff at Kew Gardens, I learn from the newspapers, has been blown down. It is a somewhat singular coincidence that on the 22nd October, I wrote to Sir Richard McBride, Premier of British Columbia, suggesting to him that the Provincial Government should obtain a really good specimen of a British Columbia tree for a flagstaff and ship home to London. It would be a comparatively easy matter to get one at least 200 ft. or over in length. I am indeed informed that quite recently a fine specimen, 220 ft. in length has been erected in Vancouver City.

When I wrote to the Premier about it, I had not heard of the misfortune at Kew. My idea was to have a fine Douglas Pine or Cedar erected in one of the London parks. The principal difficulty in the matter is the transit to England, very few owners of vessels like to take timber of such proportions.

I should very much like to know what is the condition of the Kew flagstaff, as I was in British Columbia some 50 years ago when it was shipped to this country, and I knew Captain Stamp, the shipper, somewhat intimately.

Yours faithfully,

(Signed) J. H. Turner.
Agent-General for British Columbia.

Office of the Agent-General for British Columbia,
8th January, 1914.

Lt.-Col. Sir D. Prain, C.M.G.

Dear Sir,

I thank you very much for your letter of the 19th ultimo, respecting the Flagstaff at Kew, and for the interesting information you append to it, being a copy of a paragraph which appeared

in the Bulletin of the Royal Gardens, Kew, March and April, 1896. I am sending a copy of this out to-day to the Hon. Sir Richard McBride, with a view to interesting him in my suggestion that the Province should present another Spar to the Gardens, and I am in hopes he will bring it before the great Timber Concerns of the Province, and induce them to select a really good one.

As an old lover of Kew Gardens, it would be a great pleasure to me to be able to inform you that the people of British Columbia were determined to be well represented in that respect in your beautiful Gardens.

Yours faithfully,

(Signed) J. H. Turner,
Agent-General for British Columbia.

Office of the Agent-General for British Columbia,
23rd February, 1914.

Lt.-Col. Sir D. Prain, C.M.G.

Dear Sir,

Referring to the Agent-General's letter to you of the 17th December last and your reply, *re* the Kew Gardens Flagstaff, a communication has to-day been received from the Hon. W. R. Ross, K.C., Minister of Lands, British Columbia, informing the Agent-General that a flagstaff could be obtained in British Columbia which would be in the neighbourhood of 225 ft. in height, asking further whether such a flagstaff would be acceptable to the Authorities of the Royal Botanic Gardens.

Yours faithfully,

(Signed) J. A. Turner,
Secretary.

Royal Botanic Gardens, Kew,
February 25th, 1914.

Dear Sir,

I am desired by the Director to acknowledge the receipt of your letter of 23rd February, informing us that a communication has been received from the Hon. W. R. Ross, K.C., Minister of Lands, British Columbia, to the effect that a flagstaff of some 225 ft. in height could be obtained in British Columbia, and asking if such a flagstaff would be acceptable for the Royal Botanic Gardens.

The Director requests me to say that a flagstaff of about the height mentioned would be very acceptable and would form a most striking and interesting feature in the Royal Botanic Gardens, Kew.

He begs to express his warm appreciation of the kind interest taken by the Agent-General and by the Minister of Lands in this matter.

I am,
Yours faithfully,
(Signed) Arthur W. Hill,
Assistant Director.

The Secretary,
Agent-General for British Columbia,
Salisbury House,
Finsbury Circus, E.C.

From this date onwards the matter was taken up enthusiastically.

The forests of British Columbia were searched by skilled woodmen until a tree was found that fulfilled the exacting ideals of the searchers, but not, we are told, until eleven trees had been felled that failed to satisfy their requirements. They found it some thirty miles north of the City of Vancouver. Like its predecessor that provided the old flagstaff at Kew, this tree also was a Douglas fir (*Pseudotsuga Douglasii*, Carrière), a conifer first discovered in 1793 by Archibald Menzies, the surgeon and botanist who accompanied Vancouver on his famous voyage of survey, and first introduced to England by David Douglas in 1827. It may be mentioned in passing that, growing at Scone in Perthshire, Douglas's birthplace, is a tree of his original introduction, now a beautiful specimen over 100 ft. high. It was planted where it now stands in 1834.

After the tree was felled, its limbs lopped off and its length reduced to about 220 ft. (as it stood in the forest it had been probably between 280 ft. and 300 ft. high) it was conveyed by rail and water to the City of Vancouver, and there shaped to its present form by expert axemen. It is square at the base for 15 ft. up, then octagonal up to 157 ft., and thence to the summit (214 ft.) it is round. It will be of interest to put on record its diameters at various heights. They are as follows:—Base 33 ins., 16 ft. up 33 ins., 52 ft. up $29\frac{3}{8}$ ins., 89 ft. up $25\frac{3}{8}$ ins., 115 ft. up $22\frac{1}{2}$ ins., 152 ft. up 19 ins., 190 ft. up 15 ins., 214 ft. up (summit) 12 ins.

The pith is not in the centre but $5\frac{1}{2}$ ins. from one side at the butt end. From the pith to the other margin there are 360 annual rings. The first 100 rings take up $17\frac{3}{4}$ ins., the second 100 rings $7\frac{5}{8}$ ins., and the next 100 rings are compressed into $3\frac{1}{2}$ ins. From these measurements Mr. J. S. Gamble infers "that the tree was a dominant one for about one hundred years, putting on diameter increment; then the surrounding crop caught it up and passed it, so that it increased in length to compete with them at the expense of its thickness. It clearly kept its place with them to the end and must have been closely surrounded, but having had the advantage of light when young was sturdier and stronger, so was probably selected as the finest of the crop."

The tree was 6 ft. in diameter at the base when felled and practically all the sapwood was taken off in the shaping. It is estimated to have been 400 years old. Its weight, after shaping, was roughly 18 tons, about four times that of the old flagstaff.

The problem of transporting it to Kew had now to be faced. A compact weight of 18 tons is of course trifling, but 18 tons spread over a length of 214 ft. of damageable material is not so easily dealt with. The Directors of the Shire line of Steamers undertook the task of conveying it from Vancouver to the River Thames. The Great War had broken out since the enterprise was initiated in the spring of 1914, and it was not until November 8th, 1915, that the s.s. *Merionethshire* left British Columbia with the staff safely laid along her decks. It had been lifted by means of a pile driver and a crane and slid on board from behind the vessel.

The *Merionethshire* arrived safely at the London Docks on December 29th, 1915, and dropped the flagstaff into the Thames. It was soon after towed up the river by a tug and moored to the bank opposite the end of the Sion Vista. Here the Royal Botanic Gardens accepted delivery. A fortunate high tide enabled our staff a few days later to haul it from the river on to the towing path. It was then rolled over the Ha-Ha on stout beams into the Gardens, and by means of rollers, planks and hauling tackle was conveyed by an intricate route to the foot of the mound on which it was to be erected. Thus, after many adventures, it arrived perfectly safe and sound at its destination. Here was lying, derelict and time-worn, its predecessor of 1861, and the two alongside each other made a very striking contrast in bulk and length.

At this time, the early part of 1916, the Government and nation had something more serious on hand than such matters as the flagstaff, so its erection had to remain in abeyance until after the day of armistice. A further delay of $2\frac{1}{2}$ years was the result, but this was not without its advantages. The pole as it laid along the ground was a source of pride to Canadians over here and an object of great interest to home visitors who were able to appreciate fully its magnificent size and length. It also enabled the wood to be treated thoroughly and conveniently with antiseptic dressings.

An attempt to arrange for the erection of the flagstaff had been made in July, 1917, when Mr. Turner, Agent-General for British Columbia, wrote to the Canadian Forestry Battalion asking them if they would be prepared to undertake the work.

In reply the Canadian Forestry Battalion expressed their readiness to erect the flagstaff, but subsequently they found themselves obliged to postpone the task owing to the urgency of their war work.

The signature of an armistice on November 11th, 1918, permitted attention to be turned once more to the problem of the erection of the flagstaff, and in continuation of the correspondence with the Agent-General in July 1917, a letter was addressed to Mr. Turner on December 18th, 1918.

To this the following reply was received:—

Office of the Agent-General for British Columbia,
19th December, 1918.

Captain A. W. Hill.

Dear Sir,

I have your letter of the 18th inst., directed to Mr. Turner, who has retired from the Agent-Generalship of British Columbia.

Some weeks ago I took up the question of raising the flagstaff with Brig.-General McDougall . . . . and he has promised to undertake the task with the assistance of his Engineers and Forestry Brigade. After I have had a further opportunity of arranging the details with General McDougall, I will write you again.

Yours faithfully,

(Signed) F. C. Wade,
Agent-General for British Columbia.

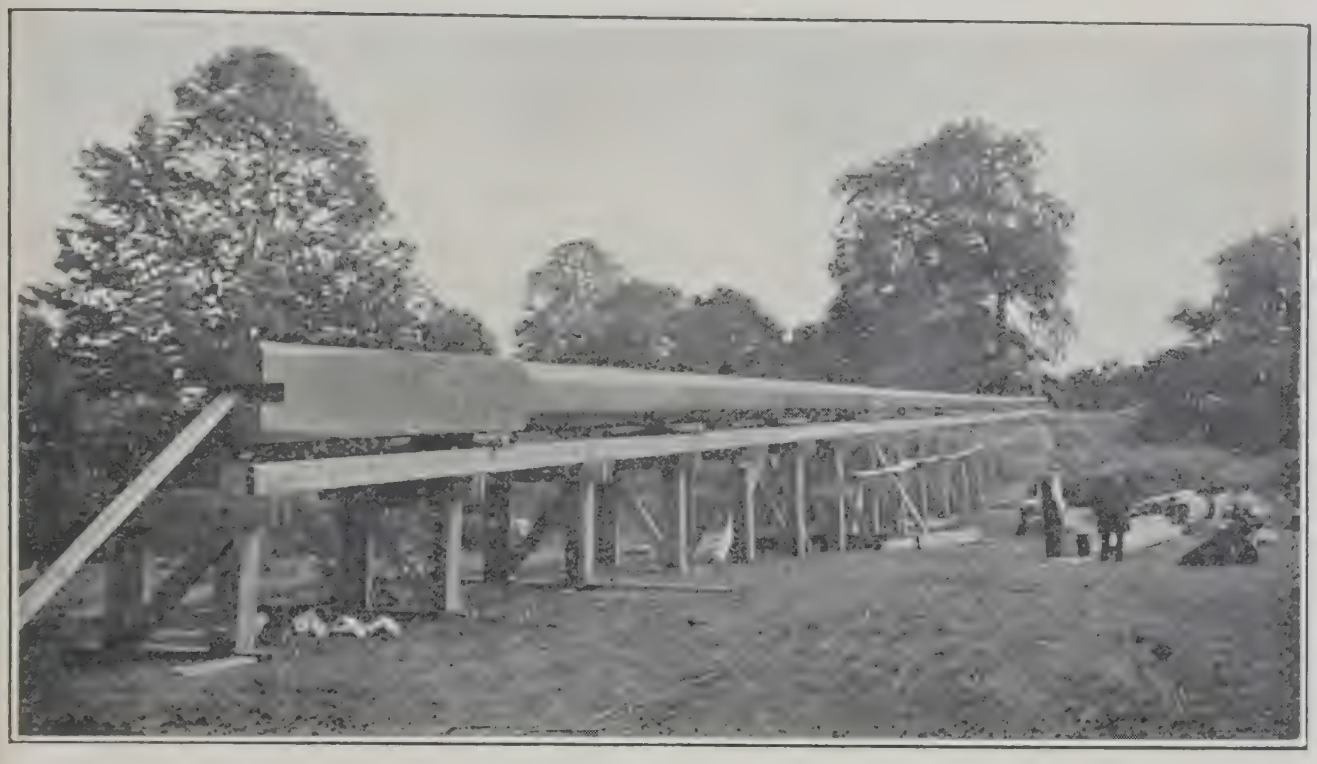
Thanks to Mr. Wade's keen interest and enthusiasm the services of several Engineer officers attached to the Canadian Forestry Corps in Europe were secured, and under their direction four huge blocks of concrete were set in the earth to which the guide-ropes of the flagstaff were to be attached. But, beyond this, the Canadians were not able to proceed. Some of them were recalled and some were given other duties, the upshot being that the problem of its erection devolved on H.M. Office of Works. The Board secured the services of Messrs. Coubro and Scrutton, professional mast-riggers, of 18, Billiter Street, E.C., by whose consulting engineer, Mr. H. Tooley, the whole operation was planned.

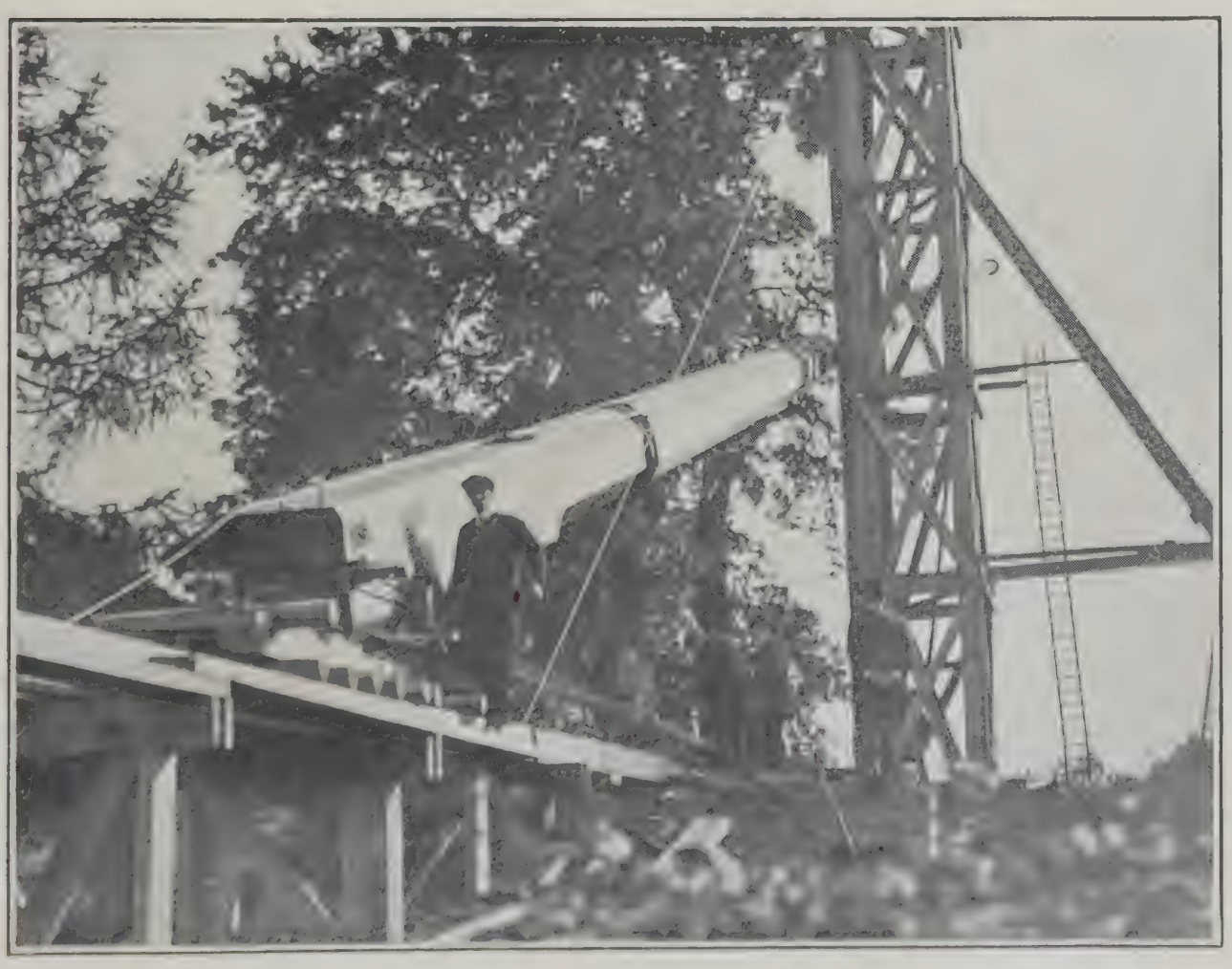
The task was successfully accomplished on October 18th, 1919, without a hitch of any kind. The process involved the erection of a derrick over 100 ft. high, constructed of planks. The pole rests with its base on the very summit of the mound, which is some 15 to 20 ft. above the natural level of the surrounding area, and thus not one inch of its splendid stature is lost. The old flagstaff had its base sunk in a ventilated brick chamber 12 ft. deep. The new one rides on a square block of steel 7 ins. in diameter, fitted into a notch at the base.

It was a matter of regret that Mr. J. H. Turner, owing to whose initiative the flagstaff was presented, was not able to be at Kew on the day of its erection.

Some acknowledgment is due from the Garden staff to the Contractors for the avoidance of any but a small amount of damage to the surrounding vegetation during this big operation. Except for the cutting down of a few of the botanical collection of lime trees at the behest of the Canadian officers, afterwards proved to be unnecessary, the injury to trees and shrubs in the neighbourhood has been practically *nil*.

The mound on which the flagstaff now stands (artificial, like all the small eminences and declivities of Kew) was the site of the





XII.

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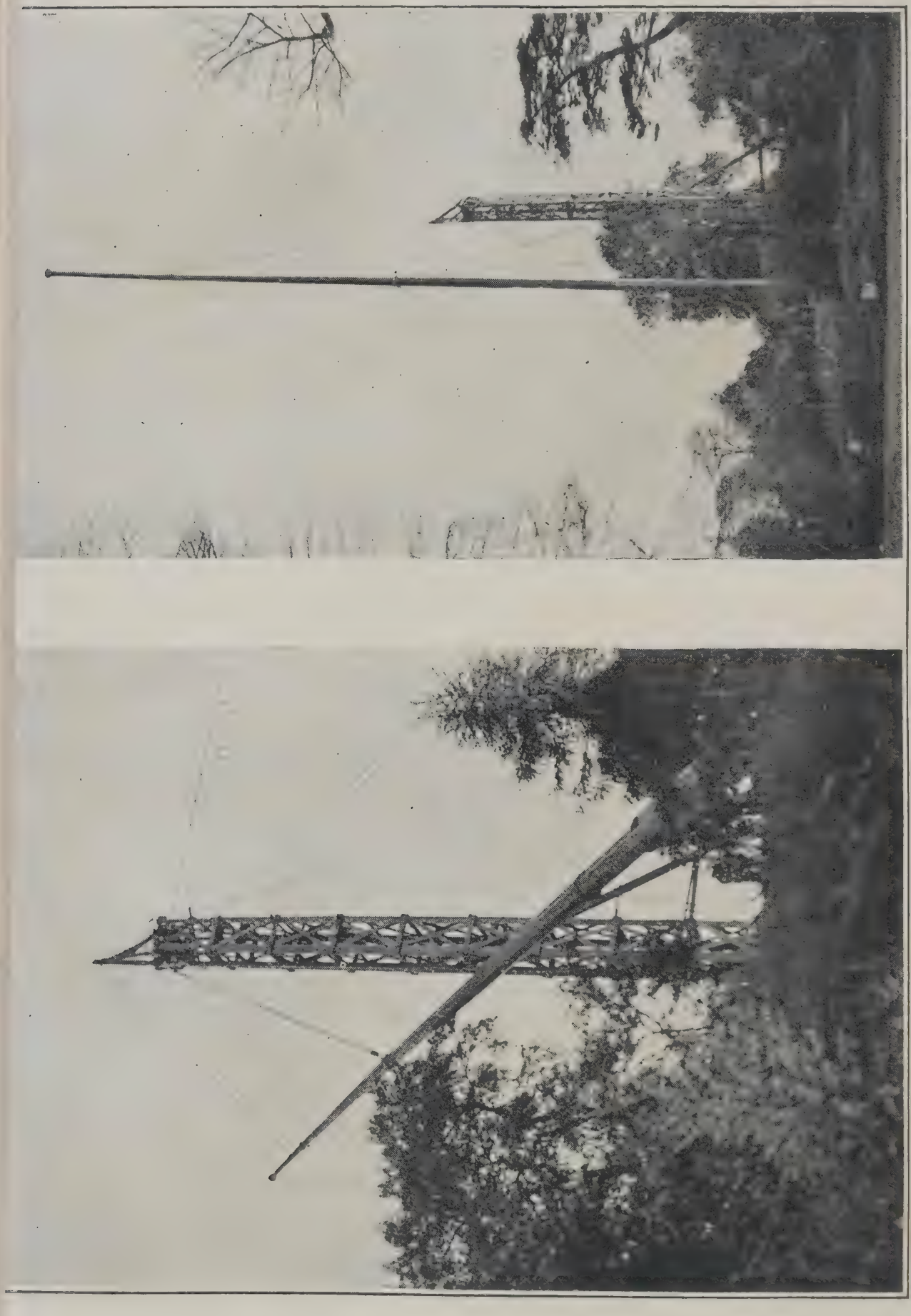

To face page 399.]

Temple of Minden, or Temple of Victory, erected to commemorate the notable British triumph at Minden on August 1st, 1759. Thus, in a sense, history is repeated, for the popular fancy is to regard the erection of the pole as a witness of the triumph of our Imperial arms over a foe greater and more sinister than that of 1759. It is pleasing to think of it as such, although the inception of the enterprise dated from before the war. But, standing there as it does, towering far above and making pygmies of our native trees, we also accept it as a magnificent "exhibit" for Kew, a testimony to the generosity and Imperial spirit of the Premier and Government of British Columbia, and an example of the marvellous tree-growths that make the forests of that fine Province some of the richest and most wonderful on the face of the globe. May its days be long!

Explanation of Plates XII. and XIII.

Plate XII.—The upper photograph shows the flagstaff on the inclined trackway leading to the mound. The flagstaff is seen resting on rollers. Note also the notch cut at the base for the steel block.

The lower photograph shows the position of the flagstaff on the afternoon of October 17th. The steel block bolted firmly in position and the base of the staff resting on a small carriage with rollers below. We are enabled to reproduce this photograph by the courtesy of London News Agency Photos Ltd.

Plate XIII.—Fig. 1.—The position of the flagstaff on the morning of October 18th, with the derrick.

Fig. 2.—The flagstaff erect on the afternoon of October 18th.

XXIX.—THE BOTANICAL SURVEY OF THE UNION OF SOUTH AFRICA.

It is with pleasure and interest that we are able to record the appointment by the Government of the Union of South Africa of an Advisory Committee to carry out and supervise a Botanical Survey of the territories included in the Union. This important enterprise, due largely to the initiative of Dr. I. B. Pole-Evans, Chief of the Division of Botany in the Department of Agriculture, Pretoria, has been under consideration for some time past and assumed practical and definite form when the Committee alluded to was appointed in the autumn, 1918.

Writing to the Director of Kew in June of this year, Dr. Pole-Evans, who is acting as Director of the Survey, made the welcome announcement that "the work of the Survey is proceeding smoothly and satisfactorily. Several of the workers have already made some progress and I feel success is assured."

The enlightenment of outlook in matters connected with the bearing of scientific knowledge on practical affairs, which experience has taught us to expect on the part of the Government of the Union of South Africa, has led to the ancillary decision explained in the subjoined communications:—

Extract from letter from Director of the Botanical Survey of the Union of South Africa, to Director, Royal Botanic Gardens, Kew, dated Division of Botany, Department of Agriculture, South Africa, 26th November, 1918.

Botanical Survey of the Union of South Africa.

Appointment of Botanical Assistant at Kew.

With reference to your letter of the 23rd of April last on the above subject and for which I am greatly indebted to you, I beg to inform you that I am now authorised by the Hon. the Minister for Agriculture to inform you that he has approved of provision being made on the Estimates of this Division for the forthcoming financial year for the salary of a Botanical Assistant at Kew in terms of your letter.

It is of course understood that the officer appointed will devote his or her whole time at Kew to work connected with the Botanical Survey of the Union and with this Division and such as the Director of Kew may think fit.

Extract from letter from Director of the Botanical Survey of the Union of South Africa, to Director, Royal Botanic Gardens, Kew, dated Division of Botany, Department of Agriculture, South Africa, 28th April, 1919.

Botanical Assistant at Kew.

Our Estimates for the year ending March, 1920, have just been passed and I have written for the necessary authority to Cape Town, where the Minister is at present, to proceed with the appointment of the Botanical Assistant at Kew in terms of your letters of the 22nd of January last and April 23rd, 1918, and by the next mail I hope to be able to write definitely on the subject.

On September 15th, 1919, a letter from the High Commissioner for the Union of South Africa, in confirmation of the letters from Dr. Pole-Evans, announced that the post of Botanical Assistant for the Union of South Africa at Kew had been duly authorised and requested the assistance and advice of the Director of Kew in the selection of a suitable incumbent for the post.

The Director was able on September 19th to inform the High Commissioner that he was fortunately in a position to put forward the name of a citizen of the Union of South Africa for favourable consideration.

On October 15th Kew was informed by the High Commissioner that he had offered the post to Miss A. G. Corbishley, a graduate of the University of South Africa, and that she had accepted the appointment.

Miss Corbishley, who is a B.A. of the University of South Africa, received her botanical training under Professor J. W. Bews at Natal University College, Pietermaritzburg.

The Advisory Committee for the Botanical Survey of the Union, consists of the following persons, and the appointment was announced in the Union of South Africa Government Gazette of October 5th, 1918:—

Dr. I. B. Pole-Evans, M.A., D.Sc., F.L.S., Chief, Division of Plant Pathology and Botany, who will also act as Director of the Survey.

Prof. J. W. Bews, M.A., D.Sc., Natal University College.

Mrs. L. Bolus, B.A., South African College, Capetown.

Prof. R. Marloth, M.A., Ph.D., Capetown.

Prof. G. Potts, M.Sc., Ph.D., Grey University College, Bloemfontein.

Prof. S. Schonland, M.A., Ph.D., F.L.S., Rhodes University College, Grahamstown.

C. E. Legat, Esq., B.Sc., Chief Conservator of Forests.

E. R. Montgomery, Esq., M.R.C.V.S., Director of Veterinary Research.

At a meeting of botanists of the Department, held at the Botanical Laboratories, Pretoria, on February 18th, 1918, it was stated that the aims and scope of the Survey are:—

1. To continue and extend the Survey and systematic work already carried out by the Division of Botany on the Vegetation of the country.

2. To continue and extend the survey work already carried out by the Division of Veterinary Research on the relation of such vegetation to the unsolved stock diseases of South Africa.

3. To continue and extend the collections of the plant parasites of the indigenous vegetation already made by the Division of Botany, and proceed with its examination as a possible reservoir of diseases of cultivated plants and of domesticated animals, and in particular map their distribution.

4. To continue and extend the work already accomplished by the Forest Department in further ascertaining the composition of the indigenous forests, the value of their products and their industrial possibilities.

5. To study the vegetation from an industrial point of view.

6. To study the vegetation in its relation to agricultural and pastoral developments.

7. To study the plant succession under natural and artificial conditions.

8. To study the vegetation of the veld in connection with its feeding value and carrying capacity and to distinguish botanically between "sour" and "sweet" velds, good and bad pastures.

9. To study the disturbing influence of burning, manuring, cultivation, drainage, irrigation, overstocking, insect and plant pests on the natural vegetation.

10. To study plant distribution according to geological, orographical and climatological conditions and the conditions which influence the different plant formations.

11. To extend their knowledge of the medicinal and poisonous plants of the country.

12. To study the influence of South African conditions on the structure and physiology of the plants of the country and in particular the causes which give rise to non-parasitic diseases.

13. To compare and correlate our flora and its associated animal and plant diseases with those existing in other parts of the world under somewhat similar telluric and climatic conditions.

14. To devote more attention to the soil and its micro-organisms.

The meeting unanimously agreed that the best means of carrying out such a survey and of securing proper organisation, co-ordination and co-operation between Government Departments concerned and voluntary workers are:—

I. That the Survey should fall under the direction of the Chief Botanist of the Union, assisted by a small Advisory Committee, consisting of not more than five members and of representatives of Government Departments interested.

II. That the country should be split up into a convenient number of botanical areas, each of which should be controlled by a botanist for that region, and who should be responsible to the Director, voluntary workers in each area being responsible to the botanist in charge.

III. That the Survey should be carried out by Government Officers as well as by voluntary workers, provided they are not put to any pecuniary loss, and that rail warrants for travelling and expenses in connection therewith be furnished and paid by the Director of the Survey from funds provided for the purpose.

IV. That the seat of the Central Herbarium with all its necessary types and records should be established at Headquarters under the direct supervision of the Director of the Survey, and that regional Herbaria should be kept in the different botanical areas under the Botanist in Charge.

V. That provision be made for the necessary qualified assistants at the Central Herbarium to deal with the plants and records submitted from the regional herbaria.

VI. That the necessary arrangements be made with the Director at Kew—where for some years a Botanical Survey of the Empire has been in progress—whereby the services of a qualified assistant could be wholly devoted to the critical examination of plants submitted.

VII. That the objects and furtherance of the Survey can be obtained only by the preparation and publication of regional floras, local floras, check-lists and all other subject matter of interest.

VIII. That these should be issued when considered advisable as Government publications under the direction of the Director of the Survey as "Memoirs of the Botanical Survey of South Africa."

IX. That the existing University Colleges and Museums should be made use of for the study of the Morphological,

Histological and Physiological problems connected with the peculiar conditions observed in South African vegetation.

Ever since Dr. Pole-Evans took charge of the Division of Botany in South Africa in 1913, the necessity of a Botanical Survey of the Union has been urged, and though the estimates did not make provision whereby the scheme could fully materialise, it is notable that during the past few years this Division, in co-operation with the Division of Veterinary Research, the Department of Forestry and private sympathisers, has made considerable progress, both by actual survey work and by the accumulation of a large amount of herbarium material, which includes the valuable collection presented by Mr. E. E. Galpin. F.L.S., to whom, with other collectors of past decades, botanists of the present and future owe a debt of gratitude. Thus were set the foundations of the Botanical Survey of the Union, now authorised by the Minister of Agriculture, and the display of such systematic use of every opportunity during a period which was naturally adverse to the elaboration of fresh schemes, augurs well for the future of the movement.

XXX.—DECADES KEWENSES

PLANTARUM NOVARUM IN HERBARIO HORTI REGII CONSERVATARUM.

DECAS XCIV.

931. **Calathodes oxycarpa,** *Sprague* [Ranunculaceae]; a *C. palmata,* Hook. f. et Thoms., folliculis paucioribus sursum angustatis nec truncatis, stylis longioribus, appendicibus dorsalibus minoribus, antheris brevioribus, foliorum segmentis haud acuminatis, serraturis brevioribus recedit.

Herba 2–3·5 dm. alta. *Folia caulina* 3–4, 5–7 cm. diametro; petioli 4–10 cm. longi; vaginae infimae 1–1·5 cm. longae, ceterae multo breviores; laminae segmenta 3, lateralia usque 5–7 mm. a basi bipartita, terminalia circumscriptione rhomboidea, lobis obtusis breviter apiculato-serratis. *Flores* solitarii, vel caule semel cymose ramoso duo; pedunculi sub anthesi circiter 3·5 cm. longi, sub fructu 6·5–8·5 cm. longi. *Sepala* 5, alba, caeruleo-tincta (*Wilson*), obovato-elliptica, 1 cm. longa, 4·5–6·5 mm. lata, 5-nervia nervis 3 interioribus quam exterioribus magis conspicuis. *Filamenta* 2·5–4·5 mm. longa; antherae oblongae, 1·5 mm. longae. *Carpella* circiter 12, toro inferne 1·5 mm. ventraliter adnata, subfalcata, stylis inclusis circiter 5 mm. longa, extra papillata, dorso prope basin gibbosula; styli recurvi, vix 1·5 mm. longi, ventraliter stigmatosi; ovula biseriata, 9. *Folliculi* 6–10, verticillati, a latere visi cymbiformes, 8 mm. longi, 4·5 mm. lati, appendice dorsali suprabasali 1·5–1·75 mm. longo in axin decurrente; styli 1·75 mm. longi. *Calathodes palmata,* Oliv. in Hook. Ic. Pl. t. 1935, quoad plantam fructiferam, non Hook. f. et Thoms.

China. Hupeh, *Henry* 6977 (fruiting specimen only). Szechuan: Mt. Wa, 2850 m. *Wilson* 3036.

Farges 924 from the Tchen-kéou-tin district of Eastern Szechuan is apparently a starved form of *C. oxycarpa*.

932. **Osbeckia travancorica,** *Bedd.* MS. in Herb. Mus. Brit., ex Gamble [Melastomaceae-Osbeckieae]; *O. Wightianae*, Benth., affinis, ramulis longe-strigosis et foliis lanceolatis sensim acuminatis longis differt.

Suffrutex erectus, ramulis griseis setis longis reflexis basi bulbosis conspicue ornatis. *Folia* lanceolata vel elliptico-lanceolata, apice sensim acuminata, basi attenuata, 7–14 cm. longa, 2–4 cm. lata, basi tricostata, additis nervorum intramarginalium 1–2 paribus gracilibus, nervis et nervulis transversis multis subparallelis, utroque pagina setis hispidis longis ornata; petiolus circiter 5 mm. longus. *Flores* in paniculas terminales parce ramosas dispositi; bracteae et bracteolae orbiculares, margine setoso-ciliatae, persistentes. *Calycis* tubus urceolatus, fasciculis setosis pedicellatis albidis ornatus; lobi 5, ovati, apice obtusi vel emarginati, margine et dorso ciliati, apice setarum longarum fasciculo praediti, intra lobos appendices pedicellati setoso-fasciculati. *Petala* 5, purpurea, obovata, ciliata, 1–1·5 cm. longa. *Antherae* 7 mm. longae, filamentis aequales. *Ovarium* apice dense setosum, stylo subulato. *Capsula* urceolata, glauca, setosa, 7 mm. longa. *Semina* multa, angulata.

South India. Travancore: in the hills at low elevations; foot of Peermede Ghat and between Cottayam and Mundakaim, Oct. 1880, *Beddome* 2976, 2878 (Herb. Mus. Brit.); at Mundakaim, *Wight*, K.D. 1100 (Herb. Kew.); *Beddome* 2977 (Herb. Mus. Brit.).

933. **Oldenlandia Bourdillonii,** *Gamble* [Rubiaceae-Hedyotideae]; *O. stylosae*, O. Kze., plus minus affinis sed pubescens, foliis membranaceis lanceolatis angustis, stipulis multidentatis differt.

Suffrutex vix 1·25 m. altus, ramulis pubescentibus griseis. *Folia* membranacea, lanceolata, apice acuminata, basi attenuata, pubescentia, circiter 4 cm. longa, 1–1·5 cm. lata, nervis primariis obliquis utrinque circiter 3–4; petiolus brevis, pubescens, 3 mm. longus; stipulae elongatae pinnatisectae, dentibus circiter 9–11 maxime villosis approximatis. *Flores* in cymam corymbosam terminalem aggregati, bracteis linearibus, bracteolis minutis. *Calycis* tubus elongatus, villosus, lobis lanceolatis. *Corolla* extus pubescens. *Capsula* adhuc ignota.

South India. Travancore: in scrub forest; 610–1200 m., August 1887, *T. F. Bourdillon* 111.

934. **Oldenlandia eualata,** *Gamble* [Rubiaceae-Hedyotideae]; *O. swertioidi*, O. Kze., affinis, foliis longis petiolatis, viridibus nec luteis, membranaceis, cymarum paniculis patentibus differt.

Suffrutex erectus, debilis, ramulis subtetragonis viridibus glabris. *Folia* membanacea, oblongo-lanceolata, apice acuminata, basi attenuata, glabra, 10–17 cm. longa, 3–5 cm. lata, nervis utrinque circiter 8–10 pallidis curvatis; petiolus ad 1·2 cm.

longus, basi dilatatus, aliquando nullus; stipulae pinnatisectae, primum paullo pubescentes, demum glabrae, dentibus paucis circiter 3–7 gracilibus apice glandulosis munitae. *Flores* in paniculam cymarum terminalem longiusculam aggregati; pedicelli graciles; bracteae et bracteolae lineares, satis conspicuae. *Calycis* tubus glaber; lobi lanceolati, 2–3 mm. longi. *Corollae* tubus elongatus gracilis. *Capsula* depresso-globosa, circiter 2 mm. longa. *Hedyotis eualata*, Bedd. M.S. in Herb. Kew.

South India. Hills of South Tinnevelly, 1200–1500 m., *Beddome* 25; Pykara Falls in Nilgiris, 1500 m., *M. A. Lawson* (1884).

935. **Oldenlandia Ramarowii,** *Gamble* [Rubiaceae-Hedyotideae]; *O. membranaceae*, O. Kze., affinis, foliis conspicue nervosis scabride puberulis et floribus pedicellatis differt. *O. Thwaitesii*, O. Kze. etiam, ramulis foliis et cymis sessilibus affinis sed stipulis maxime discrepans, et floribus pedicellatis.

Suffrutex, ramulis tetragonis crassis pallidis puberulis. *Folia* elliptica vel lanceolata, apice acuta, basi attenuata et petioli alas formantia, utraque pagina scabride puberula, subtus pallida, 8–11 cm. longa, 2–3 cm. lata, nervis primariis obliquis parallelis utrinque 7–10; petiolus 6–12 mm. longus, alatus; stipulae triangulares, pectinatae, dentibus circiter 7 curvatis puberulis. *Flores* in cymas sessiles axillares fasciculati; pedicelli graciles, 3 mm. longi; bracteae lineares, longae. *Calycis* tubus infundibuliformis, brevis, albide villosus; lobi lineari-lanceolati, 2 mm. longi. *Corollae* tubus cylindricus; lobi oblongo-lanceolati, fauce villosi. *Stamina* vix exserta. *Capsula* subglobosa, glabra.

South India. Travancore: Ponmudi; Feb. 1914, *M. Rama Row* 2373.

936. **Oldenlandia villosostipulata,** *Gamble* [Rubiaceae-Hedyotideae]; species distincta, siccitate flavescens, cymis axillaribus, pedicellis gracilibus, praecipue stipulis ovatis pectinatis conspicue multifidis villosissimis insignis.

Frutex circiter 1–1·5 m. altus, ramulis tetragonis glabris. *Folia* elliptica vel ovata, apice obtuse acuta, basi attenuata et petioli alas formantia, glabra, 3–6 cm. longa, 2–2·5 cm. lata, nervis primariis obliquis circiter 5; petiolus 3–10 mm. longus, alatus; stipulae ovatae, breves, pectinatae, fimbriis numerosis linearibus villosissimis ornatae. *Flores* in cymas axillares sessiles vel fasciculos dispositi; pedicelli graciles, 5–6 mm. longi. *Calycis* tubus brevissimus glaber; lobi lanceolati, ciliati, 3 mm. longi; tubus et lobi raphidibus conspicuis ornati. *Corollae* tubus campanulatus 5 mm. longus; lobi erecti, lanceolati, 3 mm. longi, extus glabri, intus villosi. *Stamina* paullo exserta; antherae oblongae, tenues. *Capsula* ovoidea, glabra, 2–3 mm. longa. *Semina* monuta, triquetra; testa reticulata.

South India. Travancore: Mutthukulivayal; October, 1894, *T. F. Bourdillon* 338.

937. **Oldenlandia wynaadensis,** *Gamble* [Rubiaceae-Hedyotideae]; *O. sisaparensi* (Hedyotis sisaparensis, *Gage*) affinis, foliis minoribus, stipulis triangularibus pectinatis villosis, cymis brevioribus secundis differt.

Frutex erectus insignis, ramulis albescentibus nodosis. *Folia* vix petiolata, membranacea, lanceolata, acuminata, supra pallide viridia, subtus glauca sed basin versus caerulescentia, 5–6 cm. longa, 1 1·5 cm. lata, nervis primariis utrinque circiter 4; stipulae triangulares, pectinatim longe villosodentatae. *Flores* in cymes breves paniculatas axillares glabras, 5 cm. longas dispositi; pedicelli breves; bracteae et bracteolae longae, lineares. *Calycis* tubus infundibuliformis, 2 mm. longus, glaber; lobi lineari-lanceolati, 2 mm. longi, graciles; tubus et lobi raphidibus conspicuis ornati. *Corollae* tubus cylindricus, 3–4 mm. longus; lobi patentes, lanceolati, intus villosi. *Stamina* exserta. *Capsula* depresso-globosa, glabra, 2–3 mm. longa.

South India. Wynaad: in Chambra peak forests; 1350–1800 m., *Beddome*.

938. **Ophiorrhiza Barberi,** *Gamble* [Rubiaceae - Hedyotideae]; *O. Brunonis*, W. & A., affinis, bracteolis perbrevibus, cymis laxifloris gracilibus et capsulis minoribus vix 5 mm. latis differt.

Suffrutex erectus, ramulis teretibus glabris. *Folia* lanceolata vel elliptico-lanceolata, apice caudato-acuminata, basi attenuata, 7–14 cm. longa, 2–5 cm. lata, glabra, subtus pallida, nervis utrinque 7–9 curvatis et arcuatim junctis prominulis; petiolus gracilis, 1–2 cm. longus; stipulae perbreves, pulvinatae, glandulosae. *Cymae* axillares, laxae, scorpioideae, glabrae; pedunculus communis gracilis, 2–4 cm. longus; pedicelli graciles, fere filiformes; bracteolae minutae circiter 1 mm. longae. *Calycis* tubus brevis, complanato-campanulatus, glaber; lobi brevissimi, subulati. *Corollae* tubus cylindricus, superne ampliatus, 5–7 mm. longus, intus setarum annulo conspicue ornatus; lobi ovati, patentes. *Stamina* 5, in tubo corollae inclusa, sessilia, antheris linearibus. *Ovarium* complanatum, glabrum; stylus gracilis; stigmata 2, rotundata. *Capsula* emarginata, 2 mm. longa, ad 5 mm. lata.

South India. Anamalai Hills: Paralai: Oct. 1901, *Barber* 3793: Travancore Hills: Mankulam, about 1000 m. alt., May 1915, *K. Venkoba Rao* 3143.

939. **Ophiorrhiza codyensis,** *Gamble* [Rubiaceae-Hedyotideae]; *O. pectinatae*, Arn., affinis stipulis latis ovatis diu persistentibus, cymis patentibus et foliis subtus glaucescentibus differt.

Suffrutex erectus, ramulis teretibus minute puberulis. *Folia* lanceolata, apice longe acuminata, basi in petiolum attenuata, siccitate membranacea, 8–16 cm. longa, 3–4 cm. lata, nervis utrinque 8–12 prominulis marginem versus curvatis et ibi arcuatim junctis; petiolus saepe 4 cm. longus, sed plus minus laminae basi decurrenti marginatus; stipulae conspicuae ovatae diu persistentes ad 1 cm. longae et 7 mm. latae, nervis multis parallelibus e basi ortis. *Cymae* axillares, patentes, ad 2 cm. latae, fructiferae latiores; bracteolae sessiles lanceolatae vel lineari-lanceolatae acuminatae circiter 7 mm. longae, glabrae, pedicelli brevissimi. *Calycis* dentes minuti triangulares. *Corollae* tubus cylindricus, glaber, 6–7 mm. longus, intus villosus. *Capsulae*

glabrae, 1–2 mm. longae, circiter 5 mm. latae, cystolithis conspicuis notatae.

South India. Sampagi Ghat: Coorg; Oct. 1913, *Sir A. and Lady Bourne*, 6197.

940. **Ophiorrhiza pykarensis,** *Gamble* [Rubiaceae-Hedyotideae]; species distincta foliis parvis, cymis paucifloris, bracteolis minutis insignis.

Suffrutex basi lignosus, 25–30 cm. altus, ramulis teretibus nodosis. *Folia* lanceolata, apice acuta, basi cuneata, decurrentia, subtus pallida et ad nervos pubescentia, supra glabra, 2–4 cm. longa, ad 1 cm. lata, nervis utrinque 7–8 curvatis, supra prominentibus; petiolus gracilis, ·5–1 cm. longus; stipulae minimae, triangulares, acuminatae, cito deciduae et glandulis multis ornatae. *Cymae* terminales, pauciflorae, puberulae; pedunculus communis 1–1·5 cm. longus; pedicelli 0·5–1 cm. longi; bracteolae minutae, lineari-lanceolatae. *Calycis* tubus brevis, complanato-campanulatus, pubescens; lobi brevissimi, ovati. *Corollae* tubus infundibularis, circiter 1 cm. longus, villosus, caerulescens; lobi ovati, patentes. *Stamina* 5 in tubo corollae inclusa, filamentis brevibus, antheris linearibus obtusis. *Discus* prominens, crassus, ovari apicem cingens; ovula permulta, placentis e basi divaricatis; stylus simplex parce hirsutus; stigmata 2 recurva. *Fructus* nondum repertus.

South India. Nilgiri Hills: Pykara Falls; about 2000 m. alt., May 1889, *Gamble* 20506.

XXXI.—A REVISION OF THE GENUS MENDONCIA.

W. B. Turrill.

The genus *Mendoncia* was founded by Vellozo in Vandelli, Florae Lusitanicae et Brasiliensis Specimen, p. 43 (1788). An excellent generic description is given but no specific combination is made. Flowers and fruits are figured at tab. iii. fig. 22 of this work but the name *Mendocia* is used on the plate. According to Wittstein, Etym.-bot. Handwörterbuch, the genus was named after Cardinal Mendonça, Patriarch of Lisbon. The name was altered to *Mendozia* by Ruiz and Pavon in their "Florae Peruv. et Chil. Prodromus," p. 89 (1794), and specifically indeterminable flowers and fruits are again figured (tab. xvii.). The first species, namely *Mendozia aspera* and *Mendozia racemosa*, were described by Ruiz and Pavon in "Syst. Veget. Flor. Peruv. et Chil." p. 158 (1798). Both were transferred by Nees in DC. Prod. to *Mendoncia* but one of them, *M. racemosa*, is a very doubtful species, possibly belonging to an entirely different genus. The other publications in which a number of species are described under the generic name *Mendozia* are Martius, Nov. Gen. et Spec. Pl. Brasil., iii. (1829), Poeppig et Endlich., Nov. Gen. et Spec. Plant., iii. (1845), and Martius, Flora Brasiliensis, ix. (1847).

Prior to the publication of the *Acanthaceae* in De Candolle's

Prodromus the only specific combinations with the generic name *Mendoncia* were *M. albida* and *M. coccinea*, both published by Vellozo in Florae Fluminensis, p. 263 (1825). Nees in DC. Prodromus, xi. p. 50 (1847), monographed the species at that time known, and used the correct name *Mendoncia*. Since then a number of isolated species have been described in various publications, chiefly by Lindau.

In Bentham and Hooker, Genera Plantarum, ii. p. 1072. *Mendoncia* is placed with *Thunbergia* in the tribe *Thunbergieae*. Lindau in Engler and Prantl, Pflanzenfamilien, iv. iii. B. p. 289, creates the subfamily *Mendoncioideae* for the reception of the genera *Mendoncia*, *Monochlamys* and *Afromendoncia* while *Thunbergia* is placed in the subfamily *Thunbergioideae* together with the genera *Pseudocalyx* and *Meyenia*. The following is a key to these allied genera:—

Fructus drupaceus, retinaculis nullis.
  Ovarium primo biloculare.
    Flores 1–4 in foliorum axillis; antherarum thecae longitudinaliter dehiscentes ... *Mendoncia*.
    Flores in racemis; antherarum thecae dehiscentia porosa ... ... *Monochlamys*.
  Ovarium semper uniloculare ... ... *Afromendoncia*.
Fructus capsularis, retinaculis papillosis.
  Pollinis granula sphaeroidea, sulcata.
    Antherarum thecae longitudinaliter dehiscentes *Thunbergia*.
    Antherarum thecae dehiscentia porosa... ... *Pseudocalyx*.
  Pollinis granula rotata, marginibus dentatis ... *Meyenia*.

Engelia (Karst. ex Nees in DC. Prod. xi. p. 721), is said to differ from *Mendoncia* in having the tube of the corolla provided with an anticous spur at about the middle, and the 5-partite limb split in front. This genus is reduced to *Mendoncia* in the Genera Plantarum and Lindau follows this in the Pflanzenfamilien. It seems probable that a mistake was made in the original diagnosis but it has not been possible to identify the two species described as *E. Tovarensis*, Kl. & Karst., and *E. villosa*, Kl. & Karst.

In the following revision of the genus a Latin description of each species is given. This has been considered advisable because many of the original descriptions are too imperfect for a species to be identified from them alone. Fortunately the Kew Herbarium posesses a large number of types or co-types and these have been used as bases for most of the descriptions here given.

The geography has been carefully revised by Mr. T. A. Sprague, to whom the writer tenders his thanks.

Mendoncia, *Vell.* in Vand. Fl. Lusit. et Bras. Specimen, p. 43, tab. 3, fig. 22 (1788).

Bracteolae 2, in spathae formam conspirantes, corollae tubum ad medium vel totum includentes, saepe ad margines agglutinato-connatae tunc demum plus minusve solutae, planiusculae vel carinatae. *Calyx* brevis, annularis vel cupularis, integer, saepissime membranceus, glaber vel pubescens. *Corolla* tubulosa, tubo

recto vel incurvo cylindraceo vel superne ampliato basem versus saepe gibboso vel obliquo, limbo parvo vel magno lobis 5 reflexis vel patentibus. *Stamina* 4, e tubo parte media enata, didynama, posticis parum longioribus et robustioribus, inclusa, filamentis brevibus, antheris linearibus glabris vel dorso glandulosopuberulis, thecis parallelis basi subaequalibus vel valde inaequalibus barbulatis, pollinis granulis globosis. *Discus* annularis, carnosus, valde convexus, basem ovarii includens. *Ovarium* plerumque oblique lenticulari-compressum, primo inaequaliter biloculari, demum loculo minore abortiente uniloculare ovulis in loculis 1–2, stylo filiformi sursum curvato-adscendente stigmate breviter inaequaliter bilobo terminato, lobo antico saepe majore. *Fructus* drupaceus, ovoideo-compressus, apice saepissime obliquus, mesocarpio carnoso vel pulposo, endocarpio osseo; semina 1–2, retinaculis nullis, erecta, basi lateraliter affixa, cotyledonibus plicatis corrugatis vel convolutis, radicula brevi. *Fructices* vel suffructices volubiles, pilis simplicibus vel e basi stellata orientibus instructi, caulibus inferne obsolete quadrangularibus superne teretibus vel subteretibus. *Folia* opposita, integerrima, petiolata, penninerva. *Flores* purpurei, coccinei, vel pallidi, pedicellati, pedicellis in foliorum axillis solitariis vel binis vel ternis rarissime quaternis. Nees in DC. Prodr. xi. p. 50. *Mendozia*, Ruiz & Pavon, Florae Peruv. et Chil. Prod., p. 89 (1794). *Engelia*, Karst. ex Nees in DC. Prod. xi. p. 721.

Corolla 5·5–7·5 cm. longa.
- Corolla infundibuliformis; ovarium dense pubescens.
  - Folia usque ad 1·5 dm. longa et 1 dm. lata, haud dense pubescentia; corolla 7·5 cm. longa ... ... 1. *speciosa.*
  - Folia usque ad 9 cm. longa et 4·3 cm. lata, dense flavido-pubescentia; corolla 5·5 cm. longa ... ... 2. *mollis.*
- Corollae tubus cylindricus.
  - Ovarium minute papillosum vel puberulum.
    - Folia 9–13 cm. longa, 5–7 cm. lata; bracteolae oblongae, apice subobliquе acuminatae, 4–4·5 cm. longae, 1·5 cm. latae ... ... 3. *gigas.*
    - Folia usque ad 9 cm. longa et 5 cm. lata; bracteolae oblongae, vel oblongo-ovatae, apice in acumen 5 mm. longum abrupte contractae, ad 3·5 cm. longae, 1·5 cm. latae ... 4. *Spraguei.*
  - Ovarium glabrum ... ... 5. *squamuligera.*

Corolla vix 5 cm. longa vel saepissime multo minor.
- Bracteolae hirsutae, puberulae vel villosae.
  - Bracteolae fere 4 cm. longae vel longiores.
    - Bracteolae oblanceolato-oblongae ... 6. *Tonduzii.*

Bracteolae lineari - vel lanceolato-oblongae.
Bracteolae pedicellique patule villosae.
Bracteolae apice in mucronem 6 mm. longum gradatim acuminatae ... ... 7. *pilosa.*
Bracteolae apice acutae, mucrone 2–3 mm. longo instructae ... 8. *Lindavii.*
Bracteolae pedicellique adpresse strigoso-hirsutae... ... ... 9. *Hoffmannseggiana.*
Bracteolae 3 cm. longae vel saepissime breviores.
Folia integerrima.
Bracteolae pedicellique pilis adpresse tecta.
Flores in foliorum axillis solitarii vel binis vel rarius ternis.
Bracteolae oblongo-vel lanceolato-ovatae.
Bracteolae apice obtusae, breviter mucronatae... ... 10. *coccinea.*
Bracteolae apicem versus gradatim angustatae, mucronato-acuminatae.
Bracteolae dense adpresse hirsutae ... ... 11. *aspera.*
Bracteolae sparse adpresse hirsutae.
Fructus 2 cm. longus, 1·1 cm. diametro ... 12. *Sprucei.*
Fructus 1·4 cm. longus, 8 mm. diametro ... 13. *gracilis.*
Bracteolae ellipticae ... ... 14. *costaricana.*
Flores in foliorum axillis 4–10 ... 15. *multiflora.*
Bracteolae pedicellique pilis patentibus instructae.
Bracteolae ovatae vel late ovatae, haud longe hirsutae ... ... 16. *albida.*
Bracteolae oblongae vel oblongo-ellipticae, pilis longis hirsutae.
Bracteolae oblongo - ellipticae; pedicelli circiter 2 cm. longae; corolla infundibuliformis ... 17. *puberula.*
Bracteolae oblongae; pedicelli circiter 3 cm. longi; corolla cylindrica ... ... 18. *hirsuta.*
Folia margine late planeque crenata ... 19. *crenata.*
Bracteolae glabrae vel fere glabrae.
Bracteolae 1–1·6 cm. longae.
Flores in foliorum axillis 1–2.
Pedicelli circiter 2·5 cm. longi ... 20. *glabra.*
Pedicelli 1–1·5 cm. longi ... ... 21. *Schwackeana.*
Flores in foliorum axillis 4–9 ... 22. *orbicularis.*

Bracteolae 2·5-3 cm. longae.
Bracteolae apice retusae ... ... 23. *retusa.*
Bracteolae apice rotundatae.
Bracteolae oblongae ... ... 24. *tarapotana.*
Bracteolae oblongo-obovatae ... 25. *obovata.*

1. **Mendoncia speciosa,** *Nees* in DC. Prodr. xi. p. 54 (1847).

Planta volubilis, caulibus quadrangularibus vel subquadrangularibus hirsutis. *Folia* elliptica vel late elliptica, apice cuspidato-acuminata, basi rotundata vel abrupte leviterque decurrentia, petiolo excluso usque ad 1·5 dm. longa et 1 dm. lata, pagina inferiore sparse hirsuta, superiore pilis e basi stellata orientibus instructa, costa et nervis lateralibus utrinque, infra praecipue, prominentibus, nervis tertiariis subparallelis; petiolus 3·5–6·5 cm. longus, sparse hirsutus. *Flores* solitarii, magni; bracteolae oblongo-obovatae, apice breviter cuspidatae, 3·7 cm. longae, 1·8 cm. latae, marginibus fere ad apicem agglutinato-connatae, extra sparse hirsutae, intus glabrae; pedicelli 2·5–4 cm. longi, sparse hirsuti. *Calyx* cupularis, membranaceus, 2·5 mm. longus. *Corolla* 7·5 cm. longa, 4 cm. diametro, extra glabra, alba, fauce violacea (ex *Schlim*). *Discus* annularis, carnosus, 1 mm. longus, puberulus. *Ovarium* compresso-cylindricum, leviter obliquum, 4 mm. altum, 1·5 mm. diametro, dense puberulum; stylus 3 cm. longus, inferne leviter puberulus, superne glaber. *Fructus* oblique obovoideus, lenticulari-compressus, 2·7 cm. altus, 1·2 cm. diametro, glaber.

Colombia. Dept. Magdalena: Santa Marta; Valle-dupar, Atanques, fl. and fr. Aug., *Purdie;* Santa Marta, 1370 m., fl. May, *H. H. Smith* 1137 (distributed by mistake as *Mendoncia spectabilis*, Nees ab E.). Dept. Santander; environs of Ocaña, 1220 m. fl. July, *L. Schlim* 19.

The specimen collected by *Schlim* is somewhat more hirsute than the type.

2. **Mendoncia mollis,** *Lindau* in Engl. Bot. Jahrb. 25, Beibl. lx. p. 44. (1898).

Frutex volubilis, caulibus subquadrangularibus patenti-hirsutis, internodiis circiter 12 cm. longis. *Folia* ovata vel elliptico-ovata, apice sensim acuminata et subito mucronulata, basi rotundata, usque ad 9 cm. longa et 4·3 cm. lata, supra dense pubescentia, infra densissime molliterque flavido-pubescentia, nervis lateralibus utrinque 3, cum costa pagina utraque prominentibus, petiolo 1 cm. longo densissime flavido-pubescente. *Flores* albidi vel flavo-albi (ex *Glaziou*), in foliorum axillis solitarii; pedicelli 2-2·5 cm. longi, patenter et dense flavido-pubescentes; bracteolae obovatae, apice truncato-rotundatae, mucrone 1·5 mm. longo instructae, basi rotundatae vel obtusae, 3 cm. longae, 2 cm. latae, usque ad apicem marginibus agglutinatae, extra dense flavido-pubescentes, intus leviter pubescentes. *Calyx* annularis, 2 cm. altus, pubescens. *Corolla* infundibuliformis, 5·5 cm. longa, fauce 1·2 cm. diametro. *Discus* glaber, vix 1 mm. longus. *Ovarium* oblique ovoideo-compressum,

3 mm. altum, 4 mm. diametro, dense pubescens. *Fructus* obovoideus, lenticulari-compressus, apice rotundatus vel obtusus, circiter 2 cm. longus et 1·2 cm. latus. Glaziou in Bull. Soc. Bot. France lviii. Mem. 3, 530. *M. puberula*, Glaziou, l.c.

Brazil. Minas Geraes: Serra do Caraca; in woods near Alegria, fl. June-July, *Glaziou* 16292; fr. Dec.-Jan., *Glaziou* 15289.

3. **Mendoncia gigas,** *Lindau* in Notizbl. Bot. Gart. Berlin, vi., p. 192, 1914.

Planta scandens, caule tereti pilis adpressis instructo aspero. *Folia* elliptica, apice acuminata, basi rotundata, 9–13 cm. longa, 5–7 cm. lata. supra scabra, ad costas hirsuta, subtus omnino flavo-pubescentia; petiolus 2–3 cm. longus, adpresso-hirsutus. *Flores* 2–4 in foliorum axillis; pedicelli 3–3·5 cm. longi, tomentosi; bracteolae oblongae, apice suboblique acuminatae, 4–4·5 cm. longae, 1–5 cm. latae, margine agglutinatae, extra tomentosae, intus glabrae. *Calyx* truncatus, lobulatus, 1–1·5 mm. longus, puberulus. *Corolla* purpurea, glabra, tubo 5·5 cm. longo basi 8 mm. supra basin 3·5 mm. apice 10 mm. diametro, lobis 5 rotundatis 6–7 mm. diametro. *Stamina* 4, 2 altius inserta, filamentis inferioribus 4 mm. longis, superioribus 5 mm. longis, antheris sagittiformibus thecis exterioribus longioribus 1·8 vel 1·5 cm. longis basi pilosis, interioribus basi glabris 16 vel 13 mm. longis, ad rimas pilis glanduligeris minimis obsitis; pollinis granula globosa, typica, 50–54 μ diametro. *Discus* 1·5 mm. altus. *Ovarium* 3 mm. altum, puberulum; stylus 4·5 cm. longus, glaber, stigmate bilobo. *Fructus* 2 cm. longus, 8 mm. latus, 7 mm. crassus, apice oblique acuminatus, puberulus.

Brazil. Amazonas: Rio Acre; near Seringal Auristella, fl. and fr. April, *E. Ule* 9800 ex Lindau l.c.

4. **Mendoncia Spraguei,** *Turrill*, sp. nov.

Suffrutex volubilis, caulibus subteretibus, patule fulvo-hirsutis internodiis usque ad 13 cm. longis. *Folia* elliptico-ovata, apice acuminata, basi rotundata vel leviter acuta, usque ad 9 cm. longa et 5 cm. lata, nervis lateralibus utrinque circiter 4 pagina utraque prominentibus marginem versus sursum curvatis, inferiore hirsuta, superiore pilis distinctis e basi stellata orientibus tecta; petiolus 1·5–2 cm. longus, patule fulvo-hirsutus. *Flores* saepissime 3 in foliorum axillis: bracteolae oblongae vel oblongo-ovatae, apice in acumen 5 mm. longum abrupte contractae, basi rotundatae, usque ad 3·5 cm. longae et 1·5 cm. latae, costa media prominente, nervis lateralibus obscuris, extra fulvo-hirsutae, intus glabrae, marginibus fere ad apices agglutinatis; pedicelli 1·5–2·5 cm. longi, patule fulvo-hirsuti. *Calyx* annularis, 2 mm. longus, glaber. *Corolla* usque ad 6 cm. longa, cylindrica, tubo plus minusve curvato basi 5 mm. diametro, medio 2·5 mm. diametro, fauce 7 mm. diametro, glabra, limbo quinquelobato subbilabiato. *Stamina* 4; filamenta brevissima; antherae dorso glandulosoe, duo anticae 9 mm. longae, apice hamatae, basi lobis barbatis leviter inaequalibus, duo posticae 1 cm. longae, apice complanatae, basi lobis barbatis inaequalibus; pollinis granula 56 μ diametro. *Discus* carnosus, 1 mm. altus, glaber. *Ovarium* lenticulari-ovoideum, 3 mm. altum, 2 mm. diametro, minute

papillosum; stylus usque ad 4·5 cm. longus, apice brevissime inaequaliter bifidus, parte infima papillosa excepta glaber.

Colombia. Caquetá Territory: Mocoa, *T. A. Sprague*, 402.

5. **Mendoncia squamuligera,** *Nees* in DC. Prodr. xi., p. 50 (1847).

Suffrutex scandens, caulibus adpresse hirsutis vel glabris subteretibus. *Folia* late elliptica apice rotundata breviter cuspidata, basi acuta vel rotundata vel cuneata, usque ad 12 cm. longa et 8 cm. lata, costa nervisque pagina utraque prominentibus, nervis lateralibus marginem versus sursum curvatis, utrinque 3–4, inferiore plus minusve fulvo-hirsuta, superiore fere glabra vel pilis e basi stellata orientibus instructa; petioli circiter 2 cm. longi, fulvo-hirsuti vel glabri. *Flores* 2–3 in foliorum axillis; bracteolae oblongae 4·1 cm. longae, 1·3 cm. latae, apice apiculatae, basi rotundatae, extra fulvo-hirsutae ciliataeque, intra glabra; pedicelli 1·7–7 cm. longi, graciles dense fulvo-hirsuti. *Corolla* usque ad 6·5 cm. longa, cylindrica. *Calyx* brevissimus, glaber. *Ovarium* oblique lenticulari-oblongum, 0·5 cm. altum, 2·5 mm. diametro, glabrum; stylus 4·5 cm. longus, glaber, apice sub-inaequaliter bifidus. *Fructus* oblongo-obovatus, lenticulari-compressus. apice acute apiculatus, 1·8 cm. longus, 8 mm. diametro, glaber vel fere glaber.

French Guiana. Cayenne, *Martin;* Acarouany, *Sagot* 1045; *Poiteau.*

The specimen collected by *Poiteau* has leaves with very cuneate bases. That this character is of little value is shown by Rudge's plants in Herb. Mus. Brit., for these have on the same stem leaves with rounded bases and leaves with cuneate bases.

6. **Mendoncia Tonduzii,** *Turrill*, sp. nov.

Suffrutex volubilis, caulibus tetragonis fulvo-hirsutis. *Folia* late elliptica, apice acuminata, basi usque ad 11·5 cm. longa et 6 cm. lata, costa nervis lateralibusque pagina inferiore prominentibus, superiore subprominentibus, nervis lateralibus utrinque 4–5 marginem versus sursum curvatis, tertiariis subparallelis, supra pilis e basi stellata orientibus obtecta, infra nervis praecipue dense fulvo-hirsuta et minutissime puberula; petiolus 2·5 cm. longus, dense fulvo-hirsutus. *Bracteolae* oblongo-oblanceolatae, nervo medio conspicuo praeditae, subcarinatae, apice truncatae, apiculatae, extra dense fulvo-hirsutae, intus glabrae; pedicellus usque ad 3·5 cm. longus, dense fulvo-hirsutus. *Calyx* annularis, 1 mm. longus, extra leviter hirsutus. *Corolla* alba (*Tonduz*). *Antherae* apice acuminatae, 8 mm. longae, posticae thecis inaequalibus, basi breviter barbato-puberulis exceptis glabrae; pollinis granulae circiter 48 μ diametro. *Discus* carnosulus, annularis, 1 mm. altus, glaber. *Ovarium* oblongo-ovatum, lenticulari-compressum, 3 mm. altum, basi 2 mm. latum, minutissime puberulum; stylus basi minutissime puberula excepta glaber, apice breviter inaequaliter bifidus.

Costa Rica. Tucurrique, *A. Tonduz* 12946.

Nicaragua. Chontales Mts., *Seemann.*

7. **Mendoncia pilosa,** *Nees* in DC. Prod. xi. p. 50.

Frutex adscendens, 6-8 pedum altitudinem attingit, ramis rectis vel volubilibus teretiusculis hirtis. *Folia* late ovata, apice in cuspidem sat longum acutum attenuata, basi rotundata, 7–13 cm. longa, 5–9 cm. lata, hirsuta. *Flores* 1–4, in axillis foliorum positi; pedicelli filiformes, erecti 2·5–7·5 cm. longi; bracteolae lineari-lanceolatae, deorsum falcatae, planae, basi rotundatae, fere 4 cm. longae, 1·25 cm. latae, nervo medio valde prominulo in mucronem 6 mm. gradatim excurrente, pilis longis fulvis hirtae. *Calyx* annularis, glaber. *Corolla* fere 4 cm. longa, glabra, coccinea, tubo anguste tubuloso, superne nonnihil dilatato, limbo brevi. *Stamina* 4, filamentis perbrevibus compressis, antheris acutis fere 2·5 cm. longis, posticarum thecis basi conspicue inaequalibus; staminis quinti rudimentum minimum subuliforme, vix 2 mm. longum, inter stamina duo postica. *Ovarium* compresso-ovatum, pubescens; stylus filiformis, glaber, superne nonnihil dilatatus; stigmatis lobi subaequales. *Fructus* compresso-oblongus. *Mendozia pilosa*, Mart., Nov. Gen. et Spec. iii. p. 21, tab. 209 (1829); Poepp. et Endl. Nov. Gen. et Spec. iii. p. 11 (1845); Nees in Mart. Flor. Bras. ix., p. 11 (1847). *Mendozia granulosa*, Nees in DC. Prod. xi. p. 51 (1847).

Brazil. Amazonas: In primeval forest along the river Japurá: near Manacuru, *Martius* (l.c.); Rio Negro, near Porto dos Miranhas, *Martius* (l.c.); near Ega, *Poeppig* (ex Poepp. et Endl. l.c.).

8. **Mendoncia Lindavii,** *Rusby*, in *Mem. Torrey Bot. Club*, iv. p. 241 (1895).

Frutex volubilis, ramis vetustis sparse adpresseque hirsutis quadrangularibus, junioribus dense fulvo-hirsutis. *Folia* elliptica vel ovato-elliptica, apice acuminata, basi rotundata vel acuta, 5–18 cm. longa, 3–8 cm. lata, inferne hirsuta, superne pilis numerosis e basi stellata orientibus instructa, nervis lateralibus utrinque 4–5, costa nervisque pagina superiore subprominentibus, inferiore prominentibus, nervis tertiariis subparallelis; petiolus circiter 1 cm. longus, dense fulvo-hirsutus. *Flores* 1–3 in foliorum axillis; bracteolae lanceolato- vel lineari-oblongae leviter curvatae, apice acutae, mucrone 2–3 mm. longo instructae, 3·5 cm. longae, 8–9 mm. latae, extra dense patuleque fulvo-villosae, intus glabrae, uninerves; pedicelli usque ad 6 cm. longi, saepissime breviores, dense patuleque fulvo-villosi. *Calyx* cupularis, 1·5 mm. longus, glaber vel plus minusve pubescens. *Corolla* anguste infundibuliformis, 4·5 cm. longa, rubra (ex *Rusby*) vel intense coccinea (ex *André*) glabra, tubo 1·5 cm. supra basem constricto unilateraliter ventricoso, fauce 6 cm. diametro, lobis subaequalibus inferiore paulum longiore ovato-orbicularibus 4–5 mm. longis latisque. *Antherae* fere sessiles, in corollae tubo prope medium insertae, apice acuminatae thecis basi barbulatis, posticae 1·7 cm. longae thecis basi leviter inaequalibus, anticae 1·3 cm. longae thecis basi valde inaequalibus; pollinis granula 40 μ diametro. *Discus* annularis, carnosus, 1 mm. longus. *Ovarium* ellipsoideum, lenticulari-compressum, 3 mm. longum, 2 mm. diametro, densissime pilosum; stylus

4·3 cm. longus, glaber, apice leviter dilatatus, breviter bifidus. *Fructus* oblongo-obovatus, inaequilateralis, lenticulari-compressus, 2 cm. altus, 1 cm. latus, minute sed dense pubescens.

Guatemala. Dept. Alta Verapaz: Cubilquitz; 350 m. *H. von Tuerckheim* 7939.

Colombia. Dept. Cauca: Armada (between Barbacoas and Tuquerres), 1040 m., fl. May, *Ed. André* 3468; Dept. Antioquia; Frontino, 1200 1800 m., fl. and fr. Sept., *Lehmann* 7238; llanos of San Martin, 400 m., *J. Triana* 4030; llanos of San Martin, near Villavicencio, *Dawe* 229.

Bolivia. Dept. Cochabamba: Yungas, *A. Miguel Bang* 532; Dept. La Paz; Tipuani-Guanai, fl. Dec., *A. Miguel Bang* 1707; Mapiri, 1520 m., fl. May, *H. H. Rusby* 2405; near Inglis-Inglis, fl. Aug., *R. S. Williams* 1494; Moro, 1520–1824 m., fl. Jan. *R. Pearce.*

9. **Mendoncia Hoffmannseggiana,** *Nees* in DC. Prod. xi. p. 50 (1847).

Suffrutex volubilis, caulibus subquadrangularibus tortis adpresse pubescentibus, internodiis usque ad 15 cm. longis, nodis tumidis. *Folia* elliptica vel argutissime elliptico-obovata, acuminata vel argutissime cuspidata, basi acuta, usque ad 13 cm. longa et 6 cm. lata, costa nervis lateralibusque pagina superiore subprominentibus, inferiore prominentibus, nervis lateralibus utrinque 5–6 marginem versus sursum curvatis, teriariis subparallelis, supra pilis asperis e basi stellata orientibus obecta, infra dense adpresse hirsuta vel glabrescentia; petioli 1·5–3 cm. longi, plus minusve adpresse hirsuti. *Pedicelli* 1–2 nis in foliorum axillis, 4 7 cm. longi, dense adpresse strigoso-hirsuti; bracteolae linearioblongae, subfalcatae, breviter mucronulatae, 3–3·8 cm. longae, 1 cm. latae, extra dense adpresse strigoso-hirsutae, intus glabrae. *Calyx* annularis, vix 1 mm. longus. *Corolla* tubulosa, 4·5–5 cm. longa, glabra, limbo brevi. *Stamina* 4; antherae posticae praecipue dorso glandulosae, thecis basi breviter barbatis; posticae 1·1 cm. longae, thecis basi valde inaequalibus; anticae 1·4 cm. longae, thecis basi inaequalibus; pollinis granula circiter 40 μ diametro; filamenta 2 mm. longa. *Ovarium* oblique obovatum, lenticulari-compressum, 3 mm. altum, 2·5 mm. diametro, puberulum; stylus gracilis, apice breviter bifidus, 4 cm. longus, inferne patente puberulus, superne glaber. *Fructus* oblique obovatus, lenticulari-compressus, 1·7 cm. longus, 0·8 cm. diametro, pubescens. *Mendozia Hoffmannseggiana*, Nees in Mart, Fl. Bras. ix. p. 9 (1847). *Mendoncia Schomburgkiana*, Nees in DC. Prodr. xi. p. 50 (1847). *Mendozia pubescens*, Hoffmannsegg ex Nees l.c. p. 50 (1847).

British Guiana. *Parker;* Massaroonie, *Appun* 275; *Schomburgk* 783 (1431); Demerara, *R. Jenman* 6541.

French Guiana. *Poiteau;* Karouany, *P. Sagot* 21; Acarouany, *P. Sagot* 21.

Venezuela. Lower Orinoco: Manoa, *H. H. Rusby* and *R. W. Squires,* 146.

Brazil. Amazonas: Manaos, *Ule* 5221; Trinidad (introduced), *Crueger* 254.

10. **Mendoncia coccinea,** Vell. Fl. Flum, p. 263 (1825); vi. tab. 86.

Frutex vel suffrutex volubilis 6–10 pedes altus, totus pilis adpressis fulvo-hirsutis instructus, caulibus subquadrangularibus. *Folia* elliptica, ovata, vel oblonga, apice acuminata, basi rotundata vel subacuta, usque ad 1·4 dm. longa et 6 cm. lata, pagina superiore pilis e basi stellata orientibus tecta, inferiore dense fulvo-hirsutis praecipue in nervis, nervis lateralibus utrinque 5 pagina utraque prominentibus, tertiariis subparallelis; petiolus 0·5–2 cm. longus, adpresse hirsutus. *Flores in* foliorum axillis, solitarii, bini, rarius terni; pedicelli 2·5 usque ad 7 cm. longi, sursum leviter incrassati, dense pilis fulvis obtecti; bracteolae lanceolato-ovatae, apice obtusae, breviter cuspidatae, 2·5–3 cm. longae, circiter 1 cm. latae, marginibus fere ad apicem agglutinoso-connatae, costa prominente, extra dense fulvo-hirsutae, intus glabrae. *Calyx* annularis, brevissimus, glaber. *Corolla* 3·5–3·8 cm. longa, rubra, glabra, tubo cylindrico circiter 1 cm. supra basem constricto superne leviter ventricoso fere stricto, lobis suborbicularibus inter se subaequalibus. *Antherae* fere sessiles, acutae; posticae 1·2 cm. longae, thecis basi vix inaequalibus minute barbulatis anticae 9 mm. longae, thecis basi valde inaequalibus; pollinis granula 40 μ diametro. *Discus* annuliformis, carnosus, 1 cm. longus, glaber. *Ovarium* ellipsoideo-compressum, leviter obliquum, 2·5 mm. altum, 2 mm. diametro, dense minutissime glandulosum; stylus 2·7 cm. longus, glaber, apice breviter bifidus. *Fructus* oblongo-lenticularis, apice leviter obliquus, 1·5 cm. altus, 7 mm. diametro, glaber vel leviter puberulus. *Mendozia Velloziana*, Mart. Nov. Gen. et Spec. iii. p. 22 tab. 210 (1829); Poepp. et Endl. Nov. Gen. et Spec. iii. p. 10 (1845); Nees in Mart. Fl. Bras., vol. ix. p. 11, 1847. *Mendozia Velloziana*, Mart. var. *sphingeria*, Mart, l.c. *Mendozia lancifolia*, Presl. Sym. Bot. p. 30. t. 80 (1832). *Mendoncia Velloziana*, Nees in DC. Prod. xi. p. 52 (1847); Miquel Stirp. surinam. select., p. 127 (1850). *Mendoncia Velloziana*, Nees, var. *sphingeria*, Nees in DC. Prod. xi. p. 52 (1847).

Brazil. Bahia: Ilheos, *Blanchet;* Rio Janeiro, *Tweedie; Lhotsky* (ex *Presl.*); fl. and fr. Sept., *Bowie* and *Cunningham*; Corcovado Mts., *Miers* 3190; Corcovado Mts., by way of Laranjeiros, fl. Dec., *Burchell*; Valley of Laranjeiros, fl. June., *Burchell* 2973; Organ Mts., *Miers* 4008; *Sello* (without exact locality); Moro do Telegrapho, near Rio Janeiro, 134 (Mart. Herb. Brasil. p. 104, 1837); Santa Catherina, *Tweedie.*

var. **sparatteria,** *Turrill*, comb. nov. A planta typica bracteolis majoribus usque ad 3 cm. longis et 1·7 cm. latis basi truncatis differt. *Mendoncia Velloziana*, Nees, var. *sparatteria*, Nees, in DC. Prod. xi. p. 52 (1847). *Mendozia Velloziana*, Mart., var. *sparatteria*, Mart. Nov. Gen. et Spec. iii. p. 23. *Mendoncia fulva*, Lindau in Bull. Herb. Boiss. v. 646 (1897).

Brazil. Amazonas: Rio Uaupès; Panurè, *Spruce* 2683. Minas Geraes; near Tapinha Canga, *Gardner* 5128; Lagoa Santa, fl. Nov., *Warming.* Rio de Janeiro; *Gardner* 194; Corcovado, *Miers* 3125; between the Convent of Santa Theresa and the valley

of Larangeiros, Burchell 952; the middle part (about $\frac{2}{3}$) of the ascent up the Serra de Cubataõ fl. Dec., *Burchell* 3643.

var. **elliptica,** *Turrill*, var. nov. A planta typica bracteolis late ellipticis majoribus 3 cm. longis 2 cm. latis differt.

Colombia. *J. Triana.*

11. **Mendoncia aspera,** *Nees* in DC. Prodr. xi. p. 51 (1847). *Planta* herbacea (e *Spruce*), volubilis, caulibus subteretibus adpresse pubescentibus, nodis turgidis, internodiis usque ad 11 cm. longis saepissime brevioribus tortis. *Folia* late elliptica, apice acuminata, basi rotundata vel plus minusve inaequaliter acuta, costa nervis lateralibusque pagina superiore subprominentibus, inferiore prominentibus, nervis lateralibus utrinque 4–6, marginem versus sursum curvatis, tertiariis subparallelis, pagina utraque adpresse pubescentia vel interdum supra glabrescentia; petiolus 1–3 cm. longus, pubescens vel glabrescens. *Pedicelli* 1–3–ni in foliorum axillis, adpresse pubescentes; bracteolae lanceolato-ovatae, apicem versus gradatim angustatae, mucronato-acuminatae, circiter 2·2 cm. longae et 0·8 cm. latae, dense sericeo-hirsutae vel adpresse pubescentes, intus glabrae. *Calyx* annularis, 0·5 mm. longus. *Corolla* tubulosa, 3·4 cm. longa, extra glabra, intus glabra, tubi parte contracta leviter glandulosa excepta tubo basi dilatato leviter contracto deinde gradatim ampliató et superne cylindrico, limbo brevi 5–lobato. *Stamina* 4; antherae posticae 0·9 cm. longae thecis basi inaequalibus, anticae 1·1 cm. longae thecis basi fere aequalibus breviter barbatis exceptis glabrae; pollinis granula circiter 35 μ diametro. *Ovarium* lenticulari-compressum, ambitu oblongo-ovatum, puberulum; stylus glaber, apice fere aequaliter bifidus. *Fructus* oblongo-obovatus vel oblongus, lenticulari-compressus, fere niger (ex *Spruce*), carnosus, 1·6 cm. longus, 9 mm. latus, sparsissime puberulus. De Vriese in Nederl. Kruidk-Arch. 1. (1848), p. 353. Pulle, Vasc. Pl. Surinam, p. 431. *Mendozia aspera*, Ruiz et Pav. Syst. Veg. p. 158 (1798); Nees in Mart. Fl. Bras. ix. p. 9 (1847).

Dutch Guiana. *Miquel; Hostmann* 44; Paramaribo, *Splitgerber* (ex *De Vriese*); Paramaribo, near Poelepantje, *Kegel* 55 (ex *Pulle*).

Venezuela. Rio Casiquiare: In secondary woods, *Spruce* 3284.

Peru. Prov. Ayacucho: Woods about Monterico, 900–1200 m., *R. Pearce; Matthews* 1232.

var. **rotundifolia,** *Nees* in DC. Prod. xi. p. 51 (1847). A planta typica foliis brevioribus magisque rotundatis differt. *Mendozia rotundifolia*, Poepp. et Endl., Nov. Gen. et Spec. iii. p. 10 (1845).

Brazil. Amazonas: In primeval woods, Ega, *Poeppig*, in Herb. DC., 2194 (ex *Nees*); Bahia, *Blanchet*, in Herb. DC., 1474 (ex *Nees*).

12. **Mendoncia Sprucei,** *Lindau* in Bull. Herb. Boiss. v. p. 647 (1897).

Suffrutex scandens, caulibus longitudinaliter sulcatis tortis,

junioribus sparse pilosis, senioribus fere glabris, internodiis 10–13 cm. longis. *Folia* elliptico-ovata vel elliptico-obovata, apice acuminata, basi acuta vel subrotundata, usque ad 8 cm. longa et 4·7 cm. lata, costa et nervis lateralibus pagina utraque prominentibus, nervis lateralibus utrinque 6–8, ad marginem anastomosantibus, pagina superiore sparsissime pilosa inferiore sparse sed ad nervos saepe densius adpresse pilosa; petiolus 1–1·5 cm. longus, sparse adpresse hirsutus tenuis. *Flores* in foliorum axillis solitarii; pedicelli 5–7 cm. longi, adpresse pilosi, tenues; bracteolae oblongo-ovatae, 2·2 cm. longae, 1·1 cm. latae, apice sensim mucronato-acuminatae, basi rotundatae, extra sparse adpresse hirsutae, intra glabrae, usque ad apice fere margine agglutinatae. *Calyx* annularis, brevis, glaber. *Corolla* glabra. *Antherae* glandulosae; pollinis granula 32–48 μ diametro. *Ovarium* glabrum; stylus apice breviter bifidus, glaber. *Fructus* obovatus, 2 cm. longus, 1·1 cm. diametro, glaber, nigro-purpureus (ex *Spruce*).

Brazil. Amazonas: Rio Negro; near Sao Gabriel da Cachoeira, *Spruce* 2332.

This species is very closely relatel to *Mendoncia aspera*, Nees, and may be only a variety of it.

13. **Mendoncia gracilis,** *Turrill*, sp. nov.

Frutex volubilis, caulibus gracilibus subquadrangularibus hirsutis. *Folia* elliptica vel oblongo-elliptica, apice argutissime attenuato-acuminata, basi angustata, usque ad 8·3 cm. longa et 4 cm. lata, nervis lateralibus utrinque circiter 4 marginem versus sursum curvatis cum costa pagina utraque prominentibus, supra pilis e basi stellata orientibus instructa infra pilis e basi dilatata orientibus praedita vel nervis hirsutis exceptis glabrescentia; petiolus 1·5 cm. longus, hirsutus. *Flores* 1–2 in foliorum axillis: pedicelli usque ad 4 cm. longi, adpresse hirsuti; bracteolae oblongo-ellipticae, apice obtusae vel rotundatae, apiculatae, basi rotundatae, 1·5 cm. longae, 1 cm. latae, extra haud dense hirsutae, intus glabrae. *Calyx* brevissimus, annularis, glaber. *Corolla* 2·5 cm. longa, extra glabra, tubo basi 2·6 mm. diametro, fauce 4·6 mm. diametro. *Stamina* fere sessilia, antherae circiter 7 mm. longae, thecis basi inaequalibus; pollinis granula 38 μ diametro. *Discus* cupularis, carnosus, 1 mm. altus, glaber. *Ovarium* ellipsoideo-ovoideum, lenticulari-compressum, 2 mm. altum, basi 2 mm. diametro, glabrum; stylus 1·6 cm. longus, glaber. *Fructus* ellipsoideo-obovoideus, leviter compressus, apice apiculatus, 1·4 cm. longus, 8 mm. diametro, glaber.

Colombia. Dept. Cundinamarca: Rio Negro; Mesa Grande. 1200–1300 m., *Lehmann* 8792.

An unlocalized and unnumbered specimen collected in Colombia by *J. Triana* is probably this species, though the bracteoles are somewhat larger. Neither flowers nor fruits are present.

14. **Mendoncia costaricana,** *Örst.* in Vidensk. Meddel., 1854, p. 113.

Suffrutex volubilis, ramis subtetragonis adpresse hirsutis demum plus minusve glabratis. *Folia* petiolata, elliptica, apice

acuminata, basi acutiuscula, 7·5–9·5 cm. longa, 3–4·6 cm. lata, margine leviter revoluta, pagina superiore obscure viridia pilis minutis e basi subtilissime stellata orientibus adspersa, inferiore fuscescentia, strigilloso-pubescentia, nervis lateralibus utrinque 3–4; petioli adpresse hirsuti, 1–2·5 cm. longi. *Pedicelli* fructiferi axillares, 1–5-nis, circiter 1.5 cm. longi, adpresse hirsuti; braceolae ellipticae, concavae, mucronatae, 1·6 cm. longae, 0·7–1·0 cm. latae, hirsutae. *Calyx* annuliformis, brevissimus, truncatus. *Drupa* oblique obovata, lenticulari-compressa, mucronata, 1·4 cm. longa, 8–9 mm. lata, glabra.

Costa Rica. Aguacate and Cartago, *Örsted*.

Panama. Lion Hill Station; Aug. 1861, *S. Hayes* 368.

The author adds the following note to his description: "Affinis *Engeliae villosae*, Kl. et Karst. (DC. Prod. xi. p. 721), a qua differt foliorum indumento, ramis costalibus paucioribus, petiolis brevioribus, bracteis brevioribus et apice latioribus. Corollae in speciminibus meis desunt."

15. **Mendoncia multiflora,** *Nees* in DC. Prod. xi. p. 52 (1847).

Caules fruticosi, altissime scandentes, ramis volubilibus longissimis simplicibus teretiusculis superne obtusangulis pilosis dein glabrescentibus. *Folia* elliptica, acutissime acuminata, basi attenuata, 9 cm. longa, 5 cm. lata, supra glabra obscure viridia, subtus adpresse hirta, strigosa, mollia, subferruginea; petioli supra profunde canaliculati, hirti. *Pedicelli* axillares, crebri, 4 ad 10, basi connexi, interdum subcymosi, uniflori, obtusangŭli, petiolo breviores; bracteolae ovales vel subrotundatae, mucrone incurvo rigido terminatae, coriaceae, ad medium usque connatae, uti pedicellus pilis sericeis adpressis nitidis badiis densissime vestitae. *Calyx* minutus. *Corolla* anguste tubulosa, violacea, glabra. *Drupa* ovato-oblonga, compressa, acuta, glabra. *Mendozia multiflora*, Poepp. et Endl. Nov. Gen. et Spec. iii., p. 10, tab. 208, fig. 1–3 (1845); Nees in Mart. Fl. Bras., vol. ix. p. 12 (1847). *Mendoncia strigosa*, Poepp. ex Nees in DC. Prod., xi. p. 52 (1847).

Brazil. Amazonas; In primeval woods near Ega, *Poeppig*.

There is some discrepancy between the description and figure given by Poeppig and Endlicher, and it is possible that the plant is very closely related to *M. puberula*, Nees, or is even a variety of that species.

Mendoncia tomentosa, Poepp. ex Nees in DC. Prod. xi. p. 52, *Mendozia tomentosa*, Poepp. ex Nees in Mart. Fl. Bras. ix. p. 12 (1847), is probably a variety or a luxuriant state of *M. multiflora*, Nees. It is described as having a grey-tomentose indumentum, suborbicular leaves and subrotund bracteoles. The type specimen (*Poeppig* 2818, in Herb. Acad. Petrop.) is said to be very incomplete.

16. **Mendoncia albida,** *Vell.* in Flor. Flumin. p. 263 (1825); vi. tab. 85 (1827).

Frutex volubilis, caulibus quadrangularibus vel subquadrangularibus hirsutis vel fere glabris. *Folia* elliptico-lanceolata

vel elliptico-ovata, apice argutissime acuminata, basi acuta vel subrotundata, usque ad 9·5 cm. longa, 2–4·5 cm. lata, costa nervis lateralibusque utrinque prominentibus, nervis lateralibus utrinque circiter 5 marginem versus sursum curvatis, pagina superiore pilis saepe e basi dilatata orientibus plus minusve obtecta, inferiore hirsuta; petiolus saepissime brevis, 0·5–2 cm. longus, hirsutus. *Flores* in foliorum axillis 1–2; pedicelli 1·5–3 cm. longi, hirsuti; bracteolae ovatae vel late ovatae apice acutae, mucrone 1–2 mm. longo instructae, basi rotundatae, usque ad 2·5 cm. longae et 1·5 cm. latae, extra plus minusve hirsutae, intus glabrae. *Calyx* cupularis, 2 mm. longus, glaber. *Corolla* infundibuliformis, tubo 2·6 cm. longo, basi 2·6 mm. diametro, 6 mm. supra basem 2 mm. diametro, fauce 8 mm. diametro, extra glabra, lobis 5 inaequalibus. *Stamina* 4, glandulosa, filamentis brevissimis, antheris 6 mm. longis, thecis basi inaequalibus; pollinis granula circiter 35 μ diametro. *Discus* cupularis, vix 2 mm. altus, carnosus, glaber. *Ovarium* oblique obovoideum, lenticulari-compressum, 2·5 mm. longum, 2·5 mm. diametro, minutissime dense puberulum; stylus 1·8 cm. longus, superne leviter crassatus, glaber.

British Guiana. *Schomburgk* 439.

Brazil. Pará: Rio Trombetas, *Spruce;* Prainha, fl. Dec., *J. W. Traill* 641; Bahia, *Blanchet* 3107; Minas Geraes; Lagoa Santa, *Warming.*

17. **Mendoncia puberula,** *Nees* in DC. Prod. xi., p. 53 (1847), pro parte majore.

Suffrutex volubilis, caulibus tetragonis tortis internodiis usque ad 1·5 cm. longis instructis, junioribus densissime hirsutis, senioribus plus minusve hirsutis vel glabratis, ad nodos incrassatis ibique densius hirsutis ramosis, ramis caulibus similibus saepe valde extenuatis, ita ut apex in longum cirrhum abeat. *Folia* elliptico-ovata, elliptica vel oblongo-elliptica apice acuminata, basi plus minusve rotundata vel breviter attenuata usque ad 11·5 cm. longa et 8·5 cm. lata sed saepissime minora, costa nervis lateralibus pagina utraque prominentibus, nervis lateralibus utrinque 5–6, tertiariis plus minusve parallelis, infra nervis praecipue hirsuta supra hirsuta vel glabrescentia, pilis in pagina superiore interdum e basi stellato-dilatata subulatis; petioli 1–4·5 cm. longi, saepissime patenti-hirsuti. *Pedicelli* 1–2 in foliorum axillis, 1–3 cm. longi, plus minusve dense patenti-hirsuti; bracteolae oblongo-ellipticae, 1·5–2 cm. longae, 1–1·3 cm. latae, apice obtusae vel rotundatae, nervo dorsali in mucronem excurrente praeditae, extra dense patenti-hirsutae vel interdum hirto-pubescentes, intus glabrae. *Calyx* annularis, brevissimus, vix 0·5 mm. longus, glaber. *Corolla* 2·2 usque ad 3·7 cm. longa, extra glabra, intus tubo in parte contracta antice glanduloso; tubus compresso-teres, ex ima basi 4 mm. diametro ampliatus deinde parum contractus, sursum gradatim ampliatus, antice plus minusve ventricosus; lobi 5, subaequales. *Stamina* 4; antherae 8 mm. longae, duae anticae loculis aequalibus, duae posticae thecis basi inaequalibus, thecis basi brevissime barbatis exceptis glabrae; filamenta in parte libera circiter 3 mm. longa, glabra;

pollinis granulis circiter 35 μ diametro. *Discus* annularis, carnosulus, 1 mm. altus, glaber. *Ovarium* lenticulari-compressum, ovatum, glabrum vel minute lepidotum; stylus glaber, apice breviter bifidus. *Fructus* lenticulari-compressus, ovatus, circiter 1·6 cm. longus et 1 cm. diametro, glaber. *Mendozia puberula*, Mart. Nov. Gen. et Spec. iii. p. 24, tab. 211 (1829); Nees in Mart. Fl. Bras. ix., p. 10 (1847). *Mendozia pubescens*, Poepp. et Endl. Nov. Gen. et Spec. iii. p. 11 (1845). *Mendoncia Sellowiana*, Nees in DC. Prod. xi. p. 53 (1847); Miquel, Stirp. Surinam. Select., p. 128 (1850). *Mendoncia Splitgerberiana*, De Vriese in Nederl. Kruidk. Arch. 1. (1848) p. 353. *Mendozia Selloviana*, Nees in Mart. Fl. Bras. ix. p. 10 (1847); Pulle, Vasc. Pl. Surinam, p. 431 (1906).

Guiana. Surinam, Paramaribo, near plant. Merveille, *Splitgerber* 546 (ex Pulle, l.c.), *Focke* 198 (ex Pulle, l.c.), Para district, near plant. la Rencontre, *Focke* 794 (ex Pulle, l.c.).

Brazil. Rio de Janeiro: Organ Mts.; about the head of the River Pacaque, *Burchell* 2080; at San Jose da Laranjerra, *Burchell* 9904; Organ Mts., *Gardner* 597; J. Miers 4009; Theresopolis, *Glaziou* 4020; (without exact locality, probably near Rio de Janeiro) *Sello*. Minas Geraes; frequent in small woods and on hedges at Lagoa Santa, fl, Dec.–Feb., *Warming*.

Colombia. Dept. Santander: Salazar, *W. Kalbreyer* 830.

Ecuador. Salango, *Hind;* without precise locality, *Sinclair*.

The specimens from Colombia and Ecuador are somewhat doubtfully placed in this species. The bracteoles and pedicels have much shorter hairs than in the typical plants from Brazil.

18. **Mendoncia hirsuta,** *Nees* in DC. Prod. xi., p. 52 (1847).

Frutex voubilis, ramis quadrangularibus pilis fulvis patentibus fere 4 mm. longis rigidis instructis. *Folia* elliptico-oblonga, interdum inaequalia, apice in acumine 1·5 cm. longo gradatim angustata, basi angustata, usque ad 14·5 cm. longa et 4·8 cm. lata, saepissime minora, nervis lateralibus utrinque 4–5, costa nervisque pagina superiore subprominentibus, inferiore prominentibus, utraque fulvo-hirsutis; petiolus 1·5–3 cm. longus. *Flores* 1–2 (saepissime 2) in foliorum axillis; pedicelli 2–3·5 cm. longi, patente fulvo-hirsuti; bracteolae oblongo-ellipticae, apice subobtusae mucrone setiforme 2 mm. longo terminatae, basi rotundatae, 2·4–2·8 cm. longae, 1·5–1·6 cm. latae, acriter carinatae, venosissimae, intus glabrae, extra pilis fulvis usque ad 3 mm. longis instructae. *Calyx* cupularis, vix 1 mm. longus, glaber. *Corolla* pallide lilacina vel alba, 3 cm. longa. *Discus* 0·75 mm. longus, glaber. *Ovarium* lenticulari-compressum, ambitu oblique oblongum, glabrum; stylus 1·4 cm. longus, apicem versus pilis nigris patentibus instructus, alioqui glaber. *Fructus* compresso-cylindricus, apice oblique dilatatus, 1·6 cm. longus, 6 mm. diametro, glaber. *M. angustifolia*, Poepp. ex Nees in DC. Prod. xi. p. 52. *Mendozia hirsuta*, Poepp. et Endl. Nov. Gen. et Spec. iii. p. 10 (1847).

British Guiana. Shore of the River Pomeroon, Sept. 1843, *R. Schomburgk*.

Dutch Guiana. *Miquel*.

French Guiana. *Poiteau.*

Colombia. Lower Magdalena river: Naranjo, fl. Dec. *Ed. André.*

Bolivia. Dept. La Paz: Tumupasa; 540 m., *R. S. Williams* 552; Coroico, *R. Pearce.*

Peru. Dept. Loreto: Maynas and Yurimaguas, *Poeppig* (ex Nees l.c.).

19. **Mendoncia crenata,** *Lindau* in Bull. Herb. Boiss. v., p. 647 (1897).

Planta scandens, caulibus subteretibus subsulcatis pubescentibus, internodiis 10 cm. superantibus. *Folia* oblonga, apice longe acuminata, basi angustata, usque ad 15 cm. longa et 7 cm. lata, pagina superiore scabro-hirsuta, inferiore molliter pubescentia, margine late planeque crenata; petiolus circiter 2 cm. longus, supra canaliculatus, pubescens. *Flores* in axillis complures; pedicelli usque ad 4 cm. longi, pubescentes; bracteolae ovatae, basi rotundatae, apice acuminatae vel rarius rotundatae, circiter 2 cm. longae et 1·3 cm. latae, ad fructum parum majores dense molliter pubescentes. *Calyx* annularis, brevis. *Fructus* glaber, drupaceus, 1·5 cm. longus, 8 mm. latus, subcompressus, apice truncatus, antice acuminatus rudimento styli instructus, postice rotundatus.

French Guiana. *Mélinon* (ex Lindau).

20. **Mendoncia glabra,** *Nees* in DC. Prod. ix., p. 52 (1847).

Planta volubilis, caulibus subquadrangularibus glabris. *Folia* elliptico-ovata, acuminata, basi rotundata vel acuta, 5–8 cm. longa, 2·5–4 cm. lata, glabra vel fere glabra, nervis lateralibus utrinque circiter 4, pagina superiore subprominentibus, inferiore prominentibus, petiolo usque ad 3 cm. longo glabro. *Flores* in foliorum axillis geminati; bracteolae ovatae, acutae, vel leviter apiculatae 1·6 cm. longae, 1·4 cm. latae, glabrae; pedicelli circiter 2·5 cm. longi, glabri, *Calyx* annularis, brevissimus, glaber. *Corolla* (ex *Nees*) angusta, tubulosa, limbo lato. *Stamina* quatuor, filamentis 1 mm. longis, antheris apice acuminatis 7 mm. longis, thecis basi brevissime barbatis, antherarum posticorum thecis basi inaequalibus, anticorum fere aequalibus; pollinis granula 40 μ diametro. *Discus* annularis, carnosus, 1 mm. longus, glaber. *Ovarium* obovoideum, 2 mm. longum, 1·5 mm. diametro, glabrum; stylus glaber, apice bifidum. *Mendozia glabra*, Poepp. et Endl., Nov. Gen. et Spec. 111., p. 10 (1845).

Peru. "Lima," *Ruiz & Pavon;* ad missionem Tocache, *Poeppig* (ex Poepp. et Endl. l.c.).

21. **Mendoncia Schwackeana,** *Lindau* in Bull. Herb. Boiss. iii., p. 361 (1895).

Planta scandens, caulibus hirsutis, dein glabrescentibus. *Folia* ovata, apice acuminata acutiuscula, basi subrotundata, 6–10 cm. longa, 3–5 cm. lata, sparse pilosa, ad costas et ad marginem densius hispidula; petioli 10–13 mm. longi, hirsuti. *Flores* axillares, solitarii, albi, pedicellis 10–15 mm. longis hirsutis; bracteolae excavatae, 15 mm. longae, in medio 14 mm.

latae, sparse (magis in margine) pilosae. *Calyx* truncatus, irregulariter fissus, circiter 1 mm. longus. *Corollae* tubus 19 mm. longus, basi 4 mm. diametro, supra basim ad 3 mm. constrictus, apice 10 mm. diametro; lobi aequales 10 mm. longi, 9 mm. lati. *Filamenta* 4 mm. longa, postica altius affixa; antherarum thecae in eadem fere altitudine affixae, 7 mm. longae, basi barbatae, connectivo apice in dentem 2 mm. longum producto; pollinis granula typica, circiter 46 μ diametro. *Discus* 1·5 mm. altus. *Ovarium*. 2·5 mm. altum; stylus 1·7 cm. longus; stigma inaequaliter bilobum.

Brazil. Minas Geraes; in thickets near Itacolumi, *Schwacke* 9029 (ex Lindau).

22. **Mendoncia orbicularis,** *Turrill*, sp. nov.

Frutex volubilis, ramosus, caulibus subteretibus leviter puberulis tunc demum glabrescentibus. *Folia* elliptico-ovata, apice acuminata, basi subrotundata vel breviter decurrentia, usque ad 11 cm. longa et 5·2 cm. lata, costa nervis lateralibusque pagina utraque subprominentibus, reticulatione impressa, nervis lateralibus marginem versus sursum curvatis, supra glabra, infra nervis leviter puberula; petiolus 2–2·5 cm. longus, glaber vel fere glaber. *Flores* 4–9 in foliorum axillis; pedicellus 1·7 cm. longus, glaber; bracteolae orbiculares, suborbiculares, vel late ovatae, apice rotundatae vel acutae, apiculatae, basi subcordatae, 1·2 cm. longae, 1·1 cm. latae, extra leviter minutissime puberulae, intus glabrae, virides (ex *Spruce*). *Calyx* annularis brevissimus, glaber. *Corolla* alba (ex *Spruce*), tubo subcylindrico, superne vix ampliato, 1 cm. longo, circiter 5 mm. diametro, lobis 5 subaequalibus. *Stamina* 4, antheris 4 mm. longis apice apiculato-spathulatis thecis basi leviter inaequalibus. *Discus* annularis, *carnosus*, 1 mm. altus, glaber. *Ovarium* oblique ovoideum, vix 2 mm. altum et 2 mm. diametro, glabrum; stylus 9 mm. longus, apice leviter bifidus, glaber.

Ecuador. At the foot of Mt. Chimborazo, 923 m., fl. July, *Spruce* 6213.

23. **Mendoncia retusa,** *Turrill*, sp. nov.

Suffrutex volubilis, ramis quadrangularibus, sparsissime hirsutis vel glabris. *Folia* ovato-elliptica vel elliptico-oblonga, acuminata, basi rotundata vel in petiolo plus minusve inaequaliter decurrentia, usque ad 10·5 cm. longa et 5·6 cm. lata, pagina utraque glabra vel sparsissime hirsuta, nervis lateralibus utrinque 4–6 cum costa supra subprominentibus, infra prominentibus, marginem versus anastomosantibus; petioli 2–4 cm. longi, sparsissime hirsuti. *Pedicelli* 2·5–3 cm. longi, glabri; bracteolae oblongae vel oblongo-obovatae, retuso-apiculatae, 2·8 cm. longae, extra fere glabrae vel sparsissime hirsutae, intra glabrae. *Calyx annularis*, 0·75 mm. longus, extra puberulus. *Discus* annularis, carnosus, 1 mm. altus. *Filamenta* 3 mm. longa; antherae 8 mm. longae, dorso glandulosae; pollinis granula 40–48 μ diametro. *Ovarium* minutissime puberulum; stylus glaber, apice breviter bifidus.

Nicaragua. *R. Tate* 291 (435).

Panama. Manmee Station; Sect. 30, *S. Hayes* 169.

24. **Mendoncia tarapotana,** *Lindau*, in Bull. Herb.. Boiss, Ser. ii., iv. p. 313 (1904).

Planta volubilis, glaberrima, caulibus acute quadrangulis vel subquadrangulis. *Folia* elliptica vel elliptico-ovata, apice acuminata, basi rotundata, petiolo 1–2 mm. incluso usque ad 12·5 cm. longa, saepissime breviora, 6–6·5 cm. lata, subcoriacea, nervis lateralibus utrinque 4–5, costa et nervis pagina utraque prominentibus, reticulatione impressa. *Flores* 1–2 in foliorum axillis positi; bracteolae oblongae, 2·5 cm. longae 1 cm. latae, apice rotundatae in mucronem brevem productae, basi rotundatae, marginibus plus minusve agglutinato-connatae; pedicellus circiter 2 cm. longus, superne auctus. *Corolla* alba, fauce purpurea, infundibuliformis, 3·5 cm. longa, tubo apice 0·5 cm. diametro, glabra, intra in fauce glandulosa. *Stamina* 4; antherae thecis basi barbulatis, fere sessiles, 2 posticae 1 cm. longae basi valde inaequales, 2 anticae 8 mm. longae basi vix inaequales; pollinis granula 48 μ diametro. *Discus* annularis, carnosus, 1 mm. altus. *Ovarium* ellipsoideum compressum 3 mm. altum, 2 mm. diametro, glabrum vel minutissime glandulosum; stylus 4 cm. longus, glaber, apice brevissime bifidus.

Peru. Dept. Loreto: near Tarapoto; in Mt. Guayrapurima, fl. Sept., *R. Spruce* 4620.

25. **Mendoncia obovata,** *Lindau* in Bull. Herb. Boiss. v. 646 (1897).

Planta volubilis, carnosula, caulibus tenuibus subteretibus tortis sparsissime adpresse hirsutis vel glabris, internodiis 9–16 cm. longis. *Folia* elliptica, apice acuminata, basi acuta, usque ad 18 cm. longa et 8 cm. lata, glabra, pagina utraque costa et nervis lateralibus prominentibus, nervis lateralibus utrinque 4–6 marginem versus sursum curvatis, nervis tertiariis plus minusve parallelis; petiolus usque ad 3 cm. longus, glaber, tenuis. *Flores* in foliorum axilis 1–2, coccinei (ex *Spruce*); pedicelli 3–3·5 cm. longi, tenues, sparsissime hirsuti; bracteolae, oblongo-obovatae, plus minusve carinatae, apice rotundatae, breviter mucronatae, extra pilis sparsissime obtectae, vel glabrae, intra glabrae, usque ad 3 cm. longae et 1·2 cm. latae, usque ad apicem fere margine agglutinatae. *Calyx* annularis,, brevis. *Antherae* thecis basi breviter barbatis exceptis glabrae; antherarum posticarum thecae basi altera longoir altera brevior, anticarum subaequales; pollinis granula circiter 48 μ diametro. *Ovarium* glabrum; stylus apice subinaequaliter breviter bifidus, glaber.

Venezuela. River Casiquiare; Vasiva and Pacimoni, fl. Jan., *Spruce* 3285.

Species dubiae.

Mendoncia Riedeliana, *Nees* in DC. Prod. xi., p. 51 (1847). *Mendozia Riedeliana,* Nees in Mart. Fl. Bras., vol. ix., p. 12 (1847).

Mendoncia Schottiana, *Nees* in DC. Prod. xi. p. 51 (1847). *Mendozia Schottiana,* Nees in Mart. Fl. Bras. vol. ix., p. 12 (1847).

Mendoncia Meyeniana, *Nees* in DC. Prod. xi., p. 51 (1847) *Mendozia Meyeniana,* Nees in Mart. Fl. Bras. vol. ix., p. 11 (1847).

Mendoncia Perottetiana, *Nees* in DC. Prod. xi., p. 53 (1847). *Mendoncia Sellowiana,* Nees, var. *Perrottiana,* Miquel, Stirp. Surinam. Select., p. 128 (1850).

Mendoncia racemosa, *Nees* in DC. Prod. xi., p. 54 (1847). *Mendozia racemosa,* Ruiz et Pav. Syst. Veg. Flor. Peruv. et Chil., p. 158 (1798); Pers. Synops. 2, p. 175 (1807).

Engelia tovarensis, *Kl. et Karst* ex Nees in DC. Prod. xi., p. 721 (1847).

Engelia villosa, *Kl. et Karst* ex Nees in DC. Prod. xi., p. 721 (1847).

Species excluda.

Mendoncia madagascariensis, Radlk. in Bremen, Abh. viii., p. 467 (1884), is *Monochlamys flagellaris,* Baker in Journ. Linn. Soc. xx., p. 217, tab. 26 (1883).

XXXII.—SPECIES PLACED BY SACCARDO IN THE GENUS PHOMA.

PART II.

W. B. Grove.

These notes are a continuation of those which have already appeared in *Kew Bulletin,* 1919, pp. 177-201, and are arranged on the same plan, all figures of spores being × 600.

Since this enquiry was undertaken with a special view to the study of *Phomopsis,* it will be advisable to summarise here what has been learnt further about the species of that form-genus. It is now known to have three kinds of spores—A-spores (true *Phomopsis* spores) fusoid and averaging 8-9 μ long, on sporophores usually longer than themselves; B-spores (*Phlyctaena* spores) filiform, flexuous or bent more or less like a walking-stick, on very short sporophores; and C-spores (*Fusicoccum* or *Septomyxa* spores) averaging 12–15 μ, fusoid and often shaped like a fish deprived of fins, on long sporophores. Between the first and the last intermediate forms may be observed, but the two are often quite distinct and produced in separate pycnidia. A and B spores have been found in the following additional species:—

Phomopsis Acanthi.
,, *denigrata.*
,, *multipunctata.*
,, *occulta.*

As regards the delimitation of the species it is plain that, while there is a considerable amount of variety, the A-spores tend to a great uniformity and are in themselves of little use. But the spores as a whole, combined with the variations in external appearance, and in the nature of the *Diaporthe* to which the *Phomopsis* belongs, enable one to delimit the species with fair success. Yet it is also plain that, until the forms of *Phomopsis* are all correlated with their ascophorous stage, it will be necessary in many cases to rely on the host-plant for their identification.

Further, there is sufficient evidence to make it highly probable that the same species can attack any part of the same plant, not only stems and branches, but twigs, petioles, leaves, fruits, and even galls.

Thus such a "species" as *P. petiolorum* (Desm.), supposed to be confined to petioles, is an absurdity which must now be given up. Its various forms must be assigned to one of the species of *Diaporthe* that infest each particular host. A similar statement may be ventured, among others, of *P. glandicola* on acorns, and *P. pterophila* on ash-keys; as knowledge becomes more accurate, we may expect these to be proved to be forms of some species on oak and ash respectively.

Some authors would take us further still in this simplifying process. It is known to all mycologists that the genus *Diaporthe* was divided by Nitschke and Saccardo into three subgenera:— (1) *Chorostate*, with clustered perithecia, (2) *Euporthe*, with scattered or gregarious perithecia immersed in the wood, and (3) *Tetrastaga*, with similar perithecia immersed in the bark; and it was held by Saccardo that two species belonging to different subgenera were different from one another, even though they occurred on the same host. If, therefore, a *Phomopsis* belonged to a *Euporthe*, it was considered to be different from a *Phomopsis* that belonged to a *Chorostate* or a *Tetrastaga* on the same plant. A good illustration is seen in *P. oncostoma* and *P. Pseudacaciae*, on *Robinia* (see *supra*, p. 179). But if von Höhnel had his way (Annal. Mycol. 1918) all this would be altered, and the three subgenera would be considered to be growth-forms merely. Thus the same species, on the same host, might have a *Chorostate* form, a *Euporthe* form, and a *Tetrastaga* form.

Nor is this the climax. He goes further and considers that, not *genera*, but *families*, should be the biological basis of distinction. Thus all the species of *Diaporthe* (and consequently of *Phomopsis*) on *Sambucus*, *Viburnum*, *Lonicera*, *Symphoricarpus*, and *Leycesteria*, should be classed together under the title *D. spiculosa*, Nits. This is lumping with a vengeance, and probably few would be ready to go so far, without more evidence.

It must be remembered that, with one exception, no cultures of these genera have yet been made. Only let our friends, the petri-dish laboratory culturists, get to work and, judging by what we see in that line to-day, the tendency will be very much the reverse of von Höhnel's. The nine or ten species on Caprifoliaceae, lumped by him under *D. spiculosa*, Nits., would more likely be split up into innumerable biological races. Luckily there is a limit to the capacity of one poor human brain: *medio tutissimus ibis*.

SPECIES TO BE TRANSFERRED TO PHOMOPSIS.

764. **Phoma acanthina,** *Sacc. & Roum.*

This is now called *Macrophoma acanthina*, Berl. & Vogl. in Syll. Addit. p. 308, and nothing more is known concerning it. It can hardly be doubted that it is a young state of a *Diplodia*, but the only specimen at hand (Roum. Fung. Gall. exs. no. 1020!) shows no sign of becoming so.

But on the same sheet were two specimens of *Phoma Acanthae*, Roum. (Fung. Gall. exs. no. 717) which obtruded themselves at once upon the eye as representing a *Phomopsis*, and on examination turned out to be evidently the same as *Phoma Acanthi*, Sacc. & D. Sacc. (Syll. xviii. 257); they agreed with the description in detail, but showed A and B spores, not A spores only, as Saccardo's did.

Phomopsis Acanthi, *Grove.*

Phoma Acanthi, Sacc. & D. Sacc. Annal. Mycol. 1905, p. 166.
Phoma Acanthae, Roum. Fung. Gall. exs. no. 717!

Pycnidia gregarious and arranged more or less longitudinally along the stem, occupying partly a large oblong bleached spot, but also extending on to the darkened (rufous-fuscous) parts surrounding it, oblong-lanceolate, 500–750 μ diam., blackish-brown, surrounded by a faint brownish stain, depressed, mouthless or opening irregularly, the apex of each pycnidium where it will open being marked by a pale dot, due to the loosened epidermis. A-spores ellipsoid, about 7 × 2 μ; B-spores about 20 × 0·75 μ, both on short sporophores. (Fig. 1, *a*.)

On dead stems of *Acanthus mollis*, Rome and Perpignan.

Probably the pycnidial stage of *Diaporthe picea* f. *Acanthi* (Sacc. Syll. i. 648). Pycnidia very imperfect, often represented merely by the darkened epidermis. As Saccardo remarks, the pycnidia occur on both the bleached and the darkened portions of the stem.

768. **Phoma Veronicae,** *Roum.*

On this exsiccatum (Roum. Fung. Gall. exs. no. 2960) there are three fungi in the Kew exemplar. The first is that named above, a true *Phoma;* the second is a *Pleospora*, to which doubtless the *Phoma* belongs, and the third is a form of *Phomopsis hysteriola*, which, since that species is not well understood, had better be described here:—

Phomopsis hysteriola, *Grove.*

f. *Veronicae* nov.

Pycnidia imperfecta, atra, lentiformia vel subglobosa, papillata, in maculis dealbatis singula vel seriata disposita, subter fibrillas ligni nidulantia (corticis partibus et superiore et interiore dilapsis) easque rima singula vel pluribus parallelibus diffindentia, tandem emergentia, halone leviter nigrescente cincta. Sporulae copiosae, lanceolati-ellipsoideae, altero saltem apice acutatae, 1–3-guttulatae, saepius curvatae vel flexae, 6–8 × 2–3 μ, sporophoris subulatis, curvulis, 10–12 μ longis, e strato molli pallide fuligineo oriundis suffultae.

Hab. in caulibus emortuis *Veronicae spicatae*, Grand Quevilly Galliae (Roum. Fung. Gall. exs. no. 2960!).

This species is distinguished from *P. striaeformis*, Dur. & Mont., under which Saccardo places it, by its occurrence on herbaceous stems where it forms little linear groups, hidden at first under the blackened fibres of the wood, and at length splitting them apart in an hysteriiform fashion. Varieties of the same species occur on *Atropa* and *Chaerophyllum*.

773. **Phoma Marrubii,** *Sacc.*

PHOMOPSIS MARRUBII, *Grove.*

Sphaeronema Marrubii, Dur. & Mont. Flor. Alg. p. 580.

Pycnidia gregarious on bleached spots, black, up to 250 μ diam., imperfect, lens-shaped, depressed, covered by the epidermis, each surrounded by a faint blackish stain and without any pale spot in the centre. Spores oblong-lanceolate, curvulous, acute below, 8–10 × 2·5 μ; sporophores subulate, curvulous, 18–20 × 2 μ, rising from a dusky-olive stratum.

On dry dead stems of *Marrubium vulgare*, Toulouse (Roum. Fung. Gall. exs. no. 2120!).

The bleached spots resemble those of *P. albicans* and *P. hysteriola*, f. *Veronicae*, but the pycnidia are slightly different and in the latter species are differently arranged. The description in Flore d'Algérie is obviously that of a *Phomopsis*, all the external points that distinguish the genus being unconsciously recorded.

778. **Phoma denigrata,** *Desm.*

PHOMOPSIS DENIGRATA, *Trav.* Flor. Ital. Crypt. ii. 230.

Phoma denigrata, Desm. in Ann. Sci. Nat. 1853, xx. 218.

Pycnidia loosely scattered more or less along the entire stem, which is blackened over the whole occupied part, 250–350 μ long, convex, irregular, longitudinally placed, black, immersed, then erumpent by the shining black papilla; pycnidial wall hard and thick above, and sometimes the whole upper part falls away as described in other species, leaving a whitish pit behind. A-spores "fusoid, biguttulate, 10–12 × 3·5–4 μ" (Sacc.): B-spores filiform, curved or hamate, 20–22 × 1 μ, on short ampulliform sporophores: C-spores broadly fusoid or fish-shaped, very acute at both ends, pluriguttulate, 12–15 × 3·5-4 μ; sporophores subulate, curvulous, but never hamate, a little longer than the spore or half as long again, rising from a dusky proliferous stratum. (Fig. 1, *b*.)

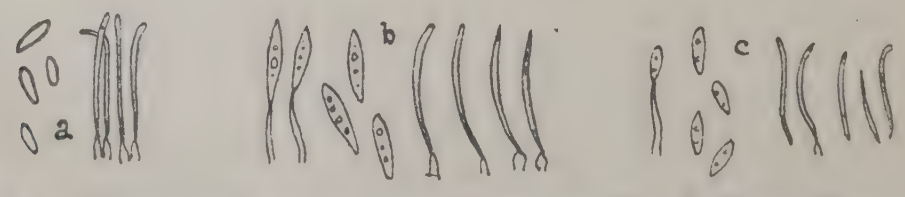

Fig. 1. *a*, *Phomopsis Acanthi*, from *Roum.* no. 717; *b*, B and C spores of *P. denigrata*; *c*, A and B spores of *P. multipunctata*.

On dead stems of *Prunella vulgaris* (Desm. Crypt. Fr. sér. ii. no. 353!). No doubt the pycnidial stage of *Diaporthe Desmazieri*, Niessl, which sometimes occurs with it. The latter has been found in Britain (*Diaporthe Labiatae*, Cooke in Grevill. v. 63), but the *Phomopsis*-stage has not yet been recorded here.

The same *Phomopsis* was issued by Vestergren (Micromyc. rarior. sel. no. 64!), on stems and leaves of *Prunella grandiflora* in Sweden. Since the leaf-form differs externally somewhat from the stem-form, a description is appended:—

Pycnidia on the fading leaves, epiphyllous, densely scattered, but the leaf is not blackened, round, convex-depressed, 250 μ diam., piercing the epidermis by the papilla, but less prominent than on the stem. The proliferous stratum is much yellower, but all the spores are the same.

B and C spores could be found in abundance in each pycnidium, but no certain A-spores could be found and their description is copied from Saccardo. Desmazières gives the A-spores as "oblong, straight, subfusiform, about 10 × 3 μ"; what Saccardo's description represents is doubtful, perhaps a confusion of A- and C-spores. There seems to be a tendency for the C-spores to become 1-septate.

This species is recorded by Diedicke on *Melampyrum*, *Euphrasia*, and *Odontites*. as well as on *Prunella*.

779. **Phoma multipunctata,** *Sacc.*

Phomopsis multipunctata, *Died.* Annal. Mycol. ix. 26.

Pycnidia crowded, arranged more or less in lines along the stem, oblong, convex, 500–700 μ long, imperfect, very black, covered by the epidermis, then opening by an impressed pore, each pycnidium surrounded by a faint black stain. A-spores elliptic-fusoid or oblong, often acute at one end, but also often obtuse at both ends, bi-tri-guttulate, 6–8 × 1·5–2 μ; sporophores subulate, acute, 10–12 μ long: B-spores filiform, flexuous or hamate, 15–20 (or occasionally 24) × 1–1½ μ, on short sporophores. (Fig. 1, *c*.)

On dead stems of *Lamium album*, Padua (Mycoth. Ven. no. 1545!). *Not* Roum. Fung. Gall. exs. nos. 5274! and 5549! (f. *major*), neither of which at all resembles Saccardo's specimens.

A very typical *Phomopsis*, recognisable as such at a naked-eye view. No doubt the pycnidial stage of *Diaporthe Tulasnei*, Nits. f. *Lamii*; it bears a close resemblance to *Phomopsis Solani*, Grove, which is also possibly a stage of the same *Diaporthe*, but, in view of the total absence of cultural experiments, the external differences are sufficient to justify their separation for the present.

792. **Phoma Spiraeae,** *Desm.*

Phomopsis Spiraeae, *Grove.*

Pycnidia gregarious, arranged longitudinally on the stem, oval, imperfect, shining, black, 250–500 μ long, immersed, not prominent, at length opening by an impressed pore, each surrounded by a brownish halo and sometimes in the midst of an

effused blackish *Diaporthe*-like stain. Spores oval-oblong or even subcylindric, but often strictly fusoid, mostly acute at both ends, occasionally rounded above, biguttulate, 8–10 × 2·5–3 μ; sporophores subulate, pointed, 12–15 μ long, with a base 2·5–3 μ wide, rising from a dark-olivaceous stratum. (Fig. 2, *a*.)

On dead stems of *Spiraea Aruncus*, France (Desm. Crypt. Fr. sér. i. no. 481!; Roum. Fung. Gall. exs. no. 1109! p.p.). Undoubtedly the spermogone of *Diaporthe Lirella*, Fckl.

When old the upper part of the pycnidium disappears, as often happens in some species of *Phomopsis;* they may then look like an old *Leptostroma*. The sporophores seem to lengthen after they have lost their spore, and look like "paraphyses"; in fact such structures have often been called by that name, both in the Coelomycetes and in the Uredinales. The British specimens on *Spiraea Ulmaria*, Kew Gardens, recorded by Cooke under the name *Phoma Spiraeae*, are mixed with *Leptostroma spiraeinum* Vest. (which Cooke mistook for *Diaporthe Lirella*), but they are certainly not a *Phomopsis*.

823. **Phoma Phytolaccae,** *Berk & Curt.*

Phomopsis Phytolaccae, *Grove*, in *Kew Bull.*, 1917, p. 66.

Septoria phlyctaenoides, Berk. & Curt. in Grevill. iii. 10.

Phlyctaena septorioides, Sacc.

Phlyctaena vagabunda, Desm. f. *Phytolaccae.*

Non *Phoma maculans*, Cooke, in Herb. in *Phytolacca decandra*, Marseilles.

Pycnidia densely scattered, situated beneath the bleached epidermis, oblong-hysteriiform with an impressed pore, or subglobose-depressed with occasionally a small papilla, at length erumpent by the vertex, black, up to 400 or 500 μ long. A-spores fusoid, more tapering below, bi-tri-guttulate, 9–10 μ long; sporophores subulate, a little longer than the spore. (Fig. 2, *b*.)

On dead stems of *Phytolacca*, New Jersey (Herb. Berk. no. 4702!). It has been suggested that this is the pycnidial stage of *Diaporthe aculeata*, Sacc., but see below.

The description is taken from Berkeley's original specimens. Berkeley noted at the time the resemblance of the spores to those of *Phoma pallens*, Berk. & Curt., which of course was merely the result of their being congeneric (See p. 184, *supra*).

On other specimens of this fungus (Ell. & Ev. North Am. Fung. ser 2, nos. 2552! and 2939!) equally from New Jersey, both B and C spores, in addition to the A-spores, occur abundantly as described below. It is worthy of notice that here again all attempts to find the three kinds of spores in the same pycnidium failed; A and B, B and C, as well as A and C spores could be found together, but not A, B, and C. This may depend upon the production of the spores at different periods of the life-history of the fungus, though this supposition does not entirely explain the matter.

The sketch given here, showing A and C spores growing side by side, can be exactly paralleled by one made by Berkeley on the sheet of his specimens of *Phoma mixta* on *Datura* (see p. 186, *supra*) as long ago as 1873, which shows accurately A and B spores

both rising from the same hymenium—a remarkable fact considering the time when it was done.

B-spores filiform, flexuous or mostly hamate, 22–25 × 0·5–0·75 μ, on very short sporophores.

C-spores fusoid or fish-shaped, acute at both ends, pluriguttulate, 12–15 × 2·5–3·5 μ, on sporophores varying from about as long to half as long again. (Fig. 2, *b*.)

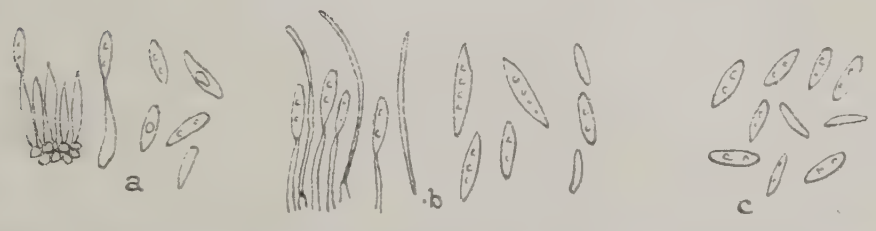

Fig. 2. *a*, *Phomopsis Spiraeae*; *b*, A, B, and C spores of *P. Phytolaccae*; *c*, *P. atriplicina*.

The shape of the C-spores resembles that of a fish from which all the fins have been removed. If they stood alone they would pass for a *Fusicoccum*, as in *Diaporthe leiphaemia*, Sacc. But, in some pycnidia, every possible length of spore between 10 and 15 μ could be found, although A and C spores were usually separated.

It will be noted that Berkeley describes the pycnidia of his *Septoria phlyctaenoides* (l.c.) as "hysteriiform"; such pycnidia do occur on the same stems side by side with the lens-shaped papillate pycnidia, but on examination both kinds were found to contain exactly similar spores. Saccardo notes (Syll. iii. 139) the presence of two kinds of spores (A and C), just as Berkeley did of the A and B spores on *Datura*, but in both cases without realising their significance.

Since *Diaporthe* (*Eu.*) *aculeata* (Schwein.) is common in the same region as the *Phomopsis*, and occurs with it, they are probably connected, though this would contradict the theory expressed *supra*, p. 179.

830. **Phoma atriplicina**, *Westd.*

PHOMOPSIS ATRIPLICINA, *Grove*.

Pycnidia gregarious, arranged more or less longitudinally on the stem, oval-oblong, 300–500 μ long, convex, black, covered by the blackened epidermis which is at length pierced by the small black papilla; when mature the blackened epidermis forms a halo round the pycnidium, finally the whole of the upper part falls away and leaves a dingy-white pit. Spores fusoid, acute at both ends, biguttulate, 8–9 × 2·5 μ; sporophores subulate, 12–20 μ long. (Fig. 2, *c*.)

On stems of *Atriplex hortensis*, Belgium (Westd. Herb. Crypt. Belg. no. 1233!).

On stems of *Kochia prostrata* there is f. *Kochiae* (Roum. Fung. Sel. Gall. no. 514!) mixed with other fungi, notably *Camarosporium Roumegueri*, var. *Kochiae*, Sacc. But Roum. Fung. Gall. exs. no. 859!, and Fung. Sel. Gall. exs. no. 214! are both quite different, though under the same name.

Diedicke seems to regard a *Phomopsis* on *Atriplex* as belonging to *Diaporthe picea*, Sacc.

835. **Phoma macropyrenia**,, *Thüm.*

On the Kew exemplar of Thümen's exsiccatum, named in his writing "*Phoma macropyrenium*, Thüm. nov. spec.," are three fungi, all black and all somewhat similar, intermingled, but differing from one another in the character of the spores and sporophores.

The first is that intended by Thümen, a true *Phoma*, having an all-round pycnidium with a wall about one cell thick.

I.—Phoma macropyrenia, *Thüm.*

Pycnidia gregarious, immersed, covered by the epidermis, then erumpent, subsuperficial, globose, about 100 μ diam., black, pierced at the vertex by a minute impressed pore; texture truly *Phoma*-like, brown, parenchymatous. Spores ellipsoid, oblong, or subcylindrical, rounded and scarcely subacute at both ends, at times somewhat curvulous, 6–8 × 2·5–3 μ (or rarely 10 μ long), rather variable, and having, apparently, in many cases, as Thümen says, "two large nuclei," *i.e.* guttules, one at each end. On closer examination, however, it is seen that this appearance is caused by what Berkeley used to call "a retraction of the protoplasm to either end," leaving a kind of vacuole in the middle. No perceptible sporophores: one spore was seen which appeared to have a median septum. (Fig. 3, *a*.)

On dead stems of *Ricinus communis*, Coimbra, Portugal, legit Moller (one of the original specimens issued by de Thümen in *Flora lusitanica*).

The specimens issued by Roumeguère under the same name (in Fung. Gall. sel. no. 4349!), from Luchon, are quite different.

The second fungus is a *Phomopsis*, which is different from *Phomopsis Ricini* described below; it may belong to *Diaporthe spiculosa*, var. *Ricini*, Trav. (Flor. Ital. Crypt. Fung. ii. 244) which should, it seems, be considered distinct from *D. spiculosa*, Nits.

II.—Phomopsis praetervisa, sp. nov.

Pycnidia copiosa, subgregaria, nec conferta, atra, rotundata, apice pertusa, interdum confluentia, ca. 250 μ diam., velata, dein erumpentia, denique parte superiore crassa dilapsa discum incusum atrum opacum epidermide fracta cinctum relinquentia. Sporulae copiosae, cylindraceo-ellipsoideae vel fusoideae, utrinque subacutae, 1–2-parviguttulatae, 8–10 × 2–2·5 μ, sporophoris stipatis, subulatis, erectis, achrois, apice saepe acutis, 16–20 × 1·5–2 μ, e strato dilute olivaceo oriundis suffultae. (Fig. 3, *b*.)

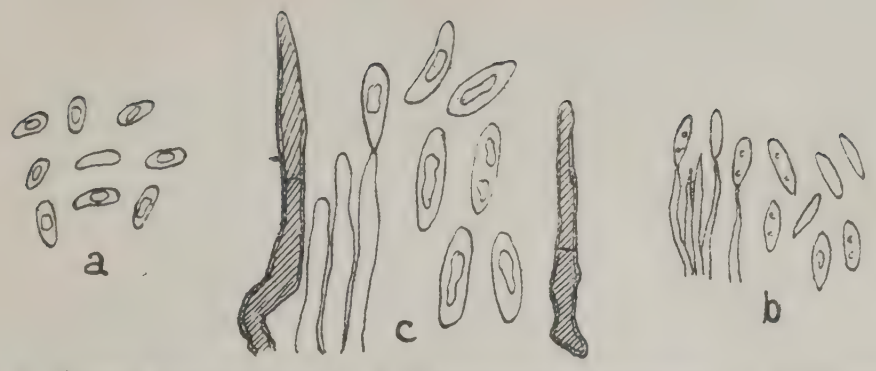

Fig. 3. *a*, *Phoma macropyrenia*; *b*, *Phomopsis praetervisa*; *c*, *Colletotrichum*, all from Moller's specimen.

Hab. ibidem. The "perithecia" described by Thümen seem to be a confusion of these two species.

This *Phomopsis* differs from *P. Ricini*, Gr. in (1) the epidermis not blackened over the pycnidium, (2) each not being surrounded by a black stain, (3) the upper part falling away and leaving a disc (*see* below, p. 437).

III.—The third fungus, which is small in quantity, is a *Colletotrichum*, very like *C. gloeosporoides*, Penz. or *C. Malvarum*, Southw. It has spores longer and more cylindric than those of the two just described, 14–18 × 4–4·5 μ, filled with granular protoplasm, and provided occasionally with an irregular guttule: the sporophores are pale-brownish, oblong, crowded, obtuse at apex, 20–35 × 3–4 μ, rising from a thick soft yellowish-brown stratum of minute parenchymatous cells. The proliferous stratum is surrounded by a small number (15–20) of inconspicuous brown hairs of the usual kind, 40–60 μ long. (Fig. 3, *c*.)

836. **Phoma Euphorbiae,** *Sacc.*

Phomopsis Euphorbiae, *Trav.* l.c. p. 233.

Pycnidia occupying little oblong-sinuous dark-grey (not black) areas of the stem, covered by the epidermis, greyish-black, about 180 μ diam. Spores oblong-ellipsoid, rather obtuse at both ends, often biguttulate, 6–7 × 2–2·5 μ; sporophores crowded, acicular, 12–14 × 1·5 μ.

On stems of *Euphorbia Characias*, Collioure, France (Roum. Fung. Gall. exs. no. 1105!). On stems of *Euphorbia palustris*, Birmingham. The pycnidial stage of *Diaporthe Euphorbiae*, Cooke.

871. **Phoma lathyrina,** *Sacc.*

Phomopsis lathyrina, *Grove.*

Pycnidia gregarious, orbicular, convex or globose-depressed, covered but rather prominent, black, somewhat shining, up to 400 μ diam., surrounded by a dull blackish halo, and sometimes two or three enclosed by a sinuous *Diaporthe*-like line, at length dropping out and leaving a paler pit; texture thick above, blackish-brown. Spores oblong-ellipsoid, subobtuse at both ends, often biguttulate, sometimes inequilateral, 8–10 × 2–2·5 μ;

sporophores crowded, erect, acicular, 16-20 × 1–1·5 μ, rising from a thick brownish stratum.

On dead pods of *Lathyrus silvestris*, Padua (Mycoth. Venet. no. 1542!).

A true *Phomopsis*, but no *Diaporthe* on *Lathyrus* seems to be known. The halo is due to dark creeping fibres. Cf. *Diaporthe inaequalis*, Nits.

893. **Phoma occulta**, *Sacc.*; and 894. **Phoma conorum**, *Sacc.*

The investigation of the specimens placed under these heads disclosed a "Comedy of Errors" which took a considerable time to unravel. Westendorp published, in Herb. Crypt. Bot. Belg. no. 913!, under the name "*Sphaeria conorum*, Desm.," a species on cone-scales of *Picea excelsa* which was not that of Desmazières, but was *Diaporthe occulta*, (Fckl.) Nits. This error was discovered by Niessl, who pointed out (in Hedwig. 1876, p. 1) that Desmazières' species was on cones of Pine and was stated by him (Ann. Sci. Nat. 1846, xvi. 76) to have ascospores measuring 8·3 μ long, while the specimens of Westendorp, Niessl said, had spores 12 μ long or more.

This correction, however, made matters worse. An examination of the Kew example of Desmazières' own co-type exsiccatum (*Sphaeria conorum*, Desm. Crypt. Fr. no. 1773!, on the rhomboidal apophysis of cone-scales of *Pinus silvestris*) shows that it possesses well-developed asci containing spores that measure 12–14 μ long, and are therefore practically indistinguishable from those of *D. occulta*. But the same exsiccatum also contains, glued on the paper by Desmazières, other scales on which were spermogones, with spores measuring about 8 × 3 μ. These are what should rightly be called *Phomopsis conorum*; evidently Desmazières gave the length of these pycnidial spores instead of that of the ascospores.

Saccardo, taking Niessl's word for it, introduced this mistake into the Sylloge (i. 647), and thus misled later mycologists. So when Muller found at Eastbourne a *Diaporthe* on cone-scales of Pine, having spores 12–14 × 4 μ, it was of course concluded by Cooke that this was *D. occulta*, instead of being as it is, *D. conorum*; so far, ascophorous *D. occulta* has not been noticed in Britain, although the late Dr. J. W. Ellis discovered the *Phomopsis*-stage at Malvern and Dolgelley.

The description of *D. occulta* in Saccardo (p. 647), taken from Nitschke, is, like all that Nitschke wrote, very accurate and complete; but as that of *D. conorum* (*ibid.*) is incorrect, a description taken from Desmazières' specimens is given below. It appears that, though the spores are so similar, the fungi differ much in outward appearance, as well as in host.

DIAPORTHE CONORUM (*Desm.*).

Stromata 3–5 mm. across, angular, distinctly limited, usually deep-black and shining outside; within, the matrix is undiscoloured but bordered by a black line. Perithecia globose, about 250 μ diam., gregarious, immersed and at first hidden, but at length bursting the epidermis and protruding slightly, showing

a short black papilla surrounded by an erect collar. Asci about 45 × 8 μ; spores biseriate, fusoid, subacute at both ends, 4-guttulate, 12–14 × 3·5–4 μ, remaining for a long time eseptate.

On the apophysis of the cone-scales of *Pinus silvestris* (Desm. Crypt. Fr. no. 1773!).

Distinguished at once from the fully developed state of *D. occulta* by the absence of the long cylindrical ostioles of the latter; in *D. occulta* the stroma is outwardly brownish-black and opaque; in *D. conorum* it is mostly shining and inky-black—in both it is bounded within by a narrow black line. The difference of host seems, so far as known, to be constant, but that question must be left for the future to decide.

Let us assume that it is constant. Then it is plain that *Phoma conorum*, Sacc. (Syll. iii. 150), since it is on "*Abies*," is not the spermogone of *Diaporthe conorum* (Desm.), as Saccardo asserts. Moreover it does not agree with Desmazières' own exsiccatum, named "*Sphaeria conorum*, Desm." It is really one of the spore-forms of *Phomopsis occulta*, Trav. (see below).

Of *Phomopsis conorum* (Desm.) ? Died. not enough was found to justify description at present, except that the spores are ellipsoid and measure 8–9 × 2·5–3 μ. Of *Phomopsis occulta* Trav. three spore-forms were seen.

Phomopsis occulta, *Trav.* l.c. p. 221.

A-spores—Pycnidia roundish or more often oblong, 200–250 μ long, black, imperfect, immersed, convex, then bursting the epidermis above for the most part in an hysteriiform manner, often arranged more or less in lines; texture rather thick above; the epidermis all round is faintly stained with blackish longitudinal streaks. Spores numerous, narrow-oblong, somewhat sausage-shaped, curved in profile view, rounded above, obliquely apiculate below, at times faintly biguttulate, 9–10 μ, then 10–13 × 2–2·5 μ, when mature; sporophores crowded, filiform, acute at apex, usually straight, 12–15 × 1–1·5 μ, rising from a soft brownish stratum.

On outer surface of cone-scales of *Picea excelsa*, at the tip, Nannau Park, Dolgelley (Ellis). (Fig. 4, *a*.)

Except that the spores are longer (? more mature), these specimens are much like those described by Fuckel (Nachtr. iii. 23). He did not issue any dried specimens of the spermogones, but observes that they occurred on the outside of the scales, on the same stroma which, on the inside, produced the ascophorous perithecia.

Here it should be noted that Fuckel (? in error) records (Symb. Myc. p. 210) the host of his *Valsa occulta* (Fung. Rhen. no. 622) as *Pinus excelsa*, whereas the scales in the exsiccatum are obviously those of *Picea excelsa*, or as he calls it thereon "*Pinus Abies*."

Those who have to examine the exsiccata issued by Roumeguère are aware that they are very disappointing, being frequently badly named and often deficient in quantity. But in this case it was decidedly different, for his exsiccatum no. 1727, under the name "*Phoma (Diaporthe) conorum*, Sacc. *Sphaeria* Desm.

West. H. C. no. 913," which is on "*Abies*," surprisingly yielded both the B and C spores of *D. occulta*.

B-spores—Pycnidia gregarious, immersed, thick-walled above, convex, black, erumpent in short hysteriiform groups. Spores numerous, filiform, but thickened subclavately upwards, falcate or hamate, obtuse at apex, much attenuated below, pluriguttulate in the upper half, 32–40 × 2 μ at the widest part; sporophores short, papilliform, rising from a thick soft pale-brownish stratum. (Fig. 4, *b*.)

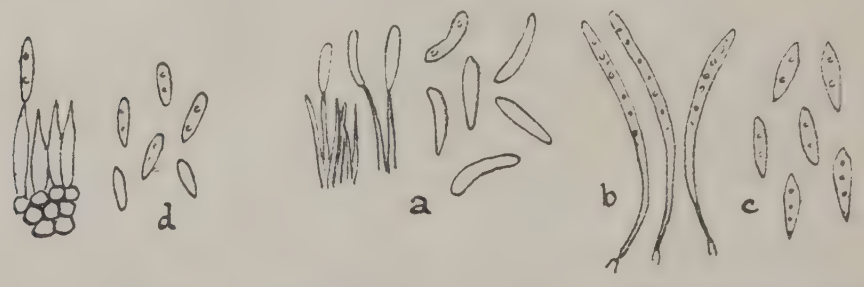

Fig. 4. *a*, A-spores; *b*, B-spores; *c*, C-spores of *Phomopsis occulta*; *d*, *Phomopsis Ricini*.

The same exsiccatum (Fung. Gall. exs. no. 1727!), as well as *ibid.* no. 1735! (under the name "*Phoma strobilina*, Desm. Pl. Cr. Fr. 1876") on the same host, yielded the C-spores.

C-spores—Pycnidia imperfect or rather with no evident pycnidial wall, convex, irregular, for the most part appearing mouthless, black, rugulose, often erumpent in an hysteriiform manner, surrounded by the laciniae of the epidermis. Spores fusoid, fish or torpedo-shaped, acute at both ends, with one or more guttules, 10–14 × 2–3 μ; sporophores acicular, 10–15 × 1 μ, rising from a thick brownish stratum. (Fig. 4, *c*.)

It will be noticed that these spores are exactly what Saccardo describes for his *Phoma conorum* (Syll. iii. 150); his "basidia uncinata, 24 × 1 μ" are no doubt the B-spores, though they seem more like the usual B-spores of a *Phomopsis* than the unusual ones described above. Perhaps both kinds occur. The C-spores are flattened, as if cut out of thick cardboard, so that in profile they look distinctly narrower, and are often curved; in face-view they might sometimes almost be described as "coffin-shaped." There was no true pycnidium: the black mass seemed to be composed entirely of spores.

It was observed that all three kinds tend to occur in short lines, and often burst the epidermis rimosely, exactly as the ascophorous stage of *D. occulta* does at times.

SPECIES TO BE TRANSFERRED TO DIPLODIEAE.

834. **Phoma Ricini**, *Sacc.*

Sphaeropsis Ricini, Cooke in Grevill. xii. 23.

Macrophoma Ricini, Berl. & Vogl. in Syll. Addit. p. 308.

? *Diplodia Ricini*, Sacc. & Roum. in Rev. Mycol. iii. 29. Syll. iii. 369.

Pycnidia densely scattered, subglobose, more or less depressed, black, covered by the epidermis, then erumpent by a small papilla, at length nearly free, up to 250 μ diam.; texture thick, *Diplodia*-like. Spores elongate-ellipsoid or subfusoid, always colourless, cloudy within, continuous, 15–23 × 5–5·5 μ. (Fig. 5, *a*.)

On stems of *Ricinus communis*, Aiken, South Carolina (Ravenel, Fung. Amer. exs. no. 543!, and Cooke, Fung. North Amer. no. 2630!).

In all these specimens the spores are in length very variable (some only 13 μ long, others reaching even 30 μ) though remaining constant in width; they are colourless, but evidently not mature, and all continuous except that in one a faint median septum could be discerned. They are closely similar to those previously treated of under the names *Phoma fusigera* and *P. fusispora* (see *supra*, pp. 191–3), and like them are strongly reminiscent of a *Diplodia*. They must all stand or fall together; in this case the *Diplodia* is probably *D. Ricini*, Sacc. & Roum., but no specimen of this was at hand for comparison.

But on the same sheet of one of Ravenel's specimens, and on the same stem which contains the "*Sphaeropsis*" just referred to, is a very different fungus:—

Phomopsis Ricini, sp. nov.

Pycnidia dense gregaria, rotundata, convexa, ca. 200 μ diam., atra, epidermide obscurata tecta, halone nigrescente cincta, tandem ostiolo emergentia; contextu partis superioris crasso, atro-brunneo. Sporulae fusoideae, utrinque subacutae, biguttulatae, 7–9 × 1·5–2 μ, sporophoris subulatis, acutis, achrois, 12–15 μ longis, deorsum 3 μ latis, e strato crasso atro-olivaceo oriundis suffultae. (Fig. 4, *d*.)

Hab. in stipite emortuo *Ricini communis*, Aiken Carolinae australis. It may be conjectured that this is the pycnidial stage of the South American *Diaporthe Ricini*, Speg.

872. **Phoma Triacanthi,** *Sacc.*

Sphaeropsis Gleditschiae, Cooke in Grevill. vi. 134 (non *Thüm.*).

Macrophoma Triacanthi, Berl. & Vogl. in Syll. Addit. p. 310.

On the sheet bearing this name are two different fungi, but probably both belonging to the same life-cycle. The first, which is that intended by Cooke, shall be described as:—

I.—Dothiorella Gleditschiae, *Grove.*

Sphaeropsis Gleditschiae, Cooke.

Pycnidia compound, forming a roundish or angular erumpent mass, 300–500 μ diam., black, convex, with a thick texture of minute dark-brown parenchymatous cells; cavity divided into several pseudo-locelli by paler translucent walls. Spores quite cylindrical, obtuse at both ends or faintly acute below, straight, hyaline; sporophores similar to the spores, but shorter. (Fig. 5, *b*.)

On legumes of *Gleditschia Triacanthos*, Aiken, South Carolina (Ravenel, nos. 250! and 2330!).

Probably a stage of the *Botryodiplodia* referred to below. See Journ. Bot. 1918, p. 294, and *Kew Bull. supra*, p. 188.

The other fungus, on the same sheet, shall be described as:—

II.—Haplosporella Gleditschiae, sp. nov.

Pycnidia in greges erumpentes confluentesque digesta, quandoque longitudinaliter seriata, atrobrunnea, ca. 300 μ lata, peridermio laciniato margine pallidiore cincta, contextu crasso parenchymatico conflata. Sporulae oblongae, utrinque rotundatae, continuae, dilute olivaceo-brunneae, plerumque 1–2-guttulatae, 16–22 × 6–10 μ, sporophoris diplodioideis, oblongis, erectis, fasciculatis, achrois, apice obtusis, ca. 30 × 9 μ suffultae. (Fig. 5, *c*.)

Hab. in ramulis *Gleditschiae Triacanthi* (Ravenel, no. 2380!) et in ejusdem leguminibus (Rav. no. 2347!), Aiken Carolinae australis.

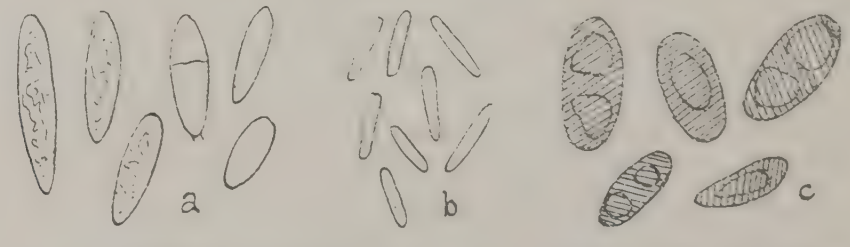

Fig. 5. *a, Sphaeropsis Ricini*, Cooke; *b, Dothiorella Gleditschiae*; *c, Haplosporella Gleditschiae.*

This cannot possibly be anything else than a young state of a *Botryodiplodia*, before the septum is developed, being exactly in the same condition as the British species which have been named *Haplosporella melogrammata*, *H. viticola*, and *H. caespitosa* (all known to be the mere states of species of *Botryodiplodia*). It is probably, therefore, = *Botryodiplodia Gleditschiae* Berl. (Sacc. Syll. x. 294), but since no specimens of that were at hand for comparison, it is recorded here under an *ad interim* name. There is every reason to believe also that the *Botryodiplodia* is a congested state of *Diplodia Gleditschiae*, Pass. (Syll. iii. 335), with *D. macrostoma*, Lév. (Syll. iii. 350) f. *Gleditschiae* as an intermediate form.

With regard to these names which are admittedly *ad interim*, pending the results of cultures to be carried out by the younger generation, it may be remarked that, so long as they are recognised to be what they are, they are a help rather than a hindrance. For many of these Imperfect Fungi occur so widely and so persistently in the unfinished state that, if no definite reference is made to that state, one who is not expert in the subject may easily go astray. It seems, therefore, a mere common-sense business precaution to list them under the preliminary name, always of course with cross-references as in a library catalogue. This does no harm except in the minds of believers in the sacrosanctity of Linnean binomials. We do not call the "fruit of an oak-tree" by that name, but "an acorn."

SPECIES TO BE TRANSFERRED TO HYALODIDYMAE.

831. **Phoma Rheea,** *Cooke.*

ASCOCHYTA RHEAE, *Grove.*

Pycnidia scattered, round, covered by the epidermis, then emergent by the upper half, about 300 μ diam., blackish, at length falling away and leaving a little white pit; texture thin, soft, plectenchymatous, brown. Spores oblong-ellipsoid, somewhat obtuse at the ends, biguttulate, for a long time continuous, at length 1-septate, not constricted, 7–9 × 3–3·5 μ; sporophores about as long as the spore.

On dead stems of *Boehmeria nivea*, Assam and Kew Gardens.

The British specimens correspond exactly with those from Assam, no doubt having been introduced with the plant. Only a few of the spores were distinctly 1-septate, but many showed indications of becoming so. This species might be placed in *Diplodina*, but it has the pycnidial texture of an *Ascochyta*; the distinction between the two genera should lie in the texture of the wall of the pycnidium, not in the nature of the habitat.

884. **Phoma cucurbitalis,** *Berk. & Curt.*

Spots none. Pycnidia gregarious, subglobose, flattened, erumpent and at length somewhat superficial, black, shining, about 100 μ diam., with a minute ostiole in the centre; texture of brown polyhedral cells, truly *Phoma*-like. Spores ovoid, rounded at the ends, biguttulate, 5–7 × 2–2·5 μ; sporophores obsolete.

On seeds of *Citrullus*, South Carolina (Herb. Berk. no. 5033!).

Though all the spores seen were continuous, there were not wanting indications (as by the constriction of numerous spores in the middle) that they would ultimately become 1-septate. The species would then belong to the genus *Diplodina*.

SPECIES TO BE TRANSFERRED TO LEPTOSTROMACEAE.

842. **Phoma hysteriiformis,** *Cooke.*

Pycnidia black, up to 500 μ long, densely gregarious and frequently confluent, forming an elongated *Hysterium*-like tubercle; mycelium arising in the epidermal cells, covered at last only by their outer walls, but penetrating deeply into the mesophyll, composed of thick-walled dark-brown parenchymatous cells, somewhat radiating at the margin, enclosing a cavity which is lined by the sporophores above and below. Spores more or less ellipsoid, obtuse at both ends, colourless, cloudy within, 12–14 × 4–6 μ; sporophores short, oblong, erect, obtuse at apex, pale brownish, sometimes transversely septate below, reminding one of those of *Piggotia astroidea*, B. & Br. (Fig. 6, *a*.)

On an herbaceous stem, Houston, Texas, legit Ravenel (Cooke, North Amer. Fung. no. 224!).

Externally very like the less crowded specimens of *Placosphaeria Onobrychidis*, var. *anaxaea* (Speg.) Keissl., as issued by

Keissler, but not like the description of *Phoma anaxaea*, Speg. (Syll. iii. 121) to which he assigns it, but of which, it is true, neither Keissler nor I have seen a specimen. Saccardo seems to be in error in regarding the latter as the spermogone of a *Diaporthe*. The fungus is also somewhat similar to specimens of *Placosphaeria Balanseana*, Sacc. & Roum. (Syll. x. 237), in external appearance. But since each stroma contains only one spore-bearing cavity, it must belong rather to the Leptostromaceae: *Placosphaeria* has numerous dothideoid cavities in each stroma, though I believe that it is more akin to the Leptostromaceae, than to the Sphaerioideae where Saccardo places it.

In view, however, of the confusion in which the Leptostromaceae now stand, with the generic limits perfectly undefined, it is useless to assign the present species to a genus. The whole group requires thorough re-examination, a long and arduous task. Thus under *Leptostroma herbarum*, Fr., we find placed by various authors species presenting at least three or four types of pycnidium, nor can these be disentangled by any other means than by examining their vertical sections.

It is known that some *Leptostromaceae* arise *between* the cuticle and the epidermal cells, others arise *within* the epidermal cells, which they ultimately destroy. The process by which the stroma arose in the present species could be clearly followed. The purplish-brown hypha starts in a single epidermal cell, branches and fills that cell with pseudo-parenchyma, then grows through the pits into the neighbouring cells, where it again branches and continues the process. Finally there is produced a cluster of epidermal cells of which the lateral walls are completely destroyed, while the mycelium also penetrates deeply into the mesophyll. Then the cuticle is burst, and round the free margin the hyphae grow outwards in a somewhat radiating fashion. Meanwhile a cavity arises in the stromatic mass, round the inside of which erect hyphae (conidiophores) produce the spores, which finally escape through a hole formed at the apex of the mass. The structure exactly resembles that of Diedicke's § A, as described for *Leptostroma Equiseti*, Jaap, and figured in his article *Die Leptostromaceen* (Annal. Mycol. 1913, xi. 177, f. 3). The name of this fungus should then be *Leptostroma hysteriiforme*, but it opens by a pore, not a slit, and therefore does not belong to *Leptostroma* in Saccardo's sense, but to *Leptothyrium*.

SPECIES TO BE TRANSFERRED TO GLOEOSPORIUM.

883. **Phoma lagenicola,** *Sacc.*

Gloeosporium Lagenariae, *Grove.*

Phoma Lagenariae, Thüm. in Contr. Myc. Flor. Lusit. ser. iii. no. 567 (1880), *non* Sacc.

There are in the Herbarium on *Lagenaria* fruits a number of specimens on which the name "*Phoma Lagenariae*, Cooke" has been written. These on examination yield numerous spores, which are evidently those of a *Gloeosporium;* there is no trace

of any pycnidial wall. The spores measure 5–6 × 2–2·5 μ, although occasional ones reach as high as 8·5 μ long. They are all obviously the same, and agree excellently well with the description of *Phoma Lagenariae*, Thüm., of which there are unfortunately no specimens for comparison. Saccardo, who also had not seen specimens, lists Thümen's species under the name *P. lagenicola.*

The following is the description of Cooke's specimens, named "*Phoma Lagenariae*," Cooke in Herb.

Spots up to 2 cm. across, roundish or (if contiguous) angular, greyish-ferruginous, with a darker border. Pustules densely gregarious, subepidermal, 200–250 μ diam., blackish, paler in the centre where the epidermis at length bursts open. Spores ovoid or oblong, hyaline, continuous, 5–6 × 2–2·5 μ, rarely longer, usually rounded at the ends, often with one or more guttules; sporophores subulate-acicular, acute, crowded, 20–25 × 1·5 μ, rising from a faintly brownish stratum. (Fig. 6, *b*.)

On epicarp of *Lagenaria vulgaris*, Marseilles, 1873, no. 55!

There is no indication by whom it was sent to Cooke, but the writing is distinctly French. If, as seems hardly in the slightest degree doubtful, it is identical with Thümen's species, its name according to the rules must be *Gloesporium Lagenariae*; it does not agree with any other described. There are no setae visible. Thümen's species was gathered by Moller in 1879.

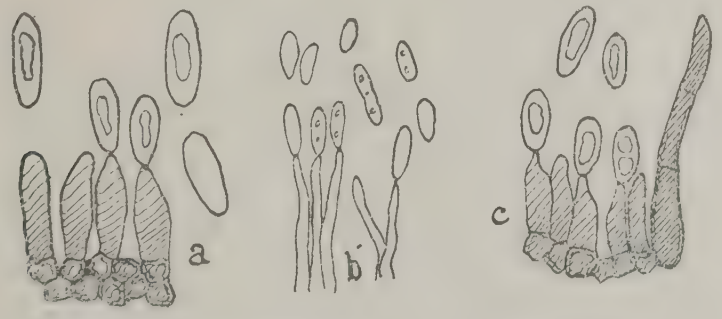

Fig. 6. *a*, "*Phoma hysteriiformis*"; *b*, "*Phoma lagenicola*", from Marseilles; *c*, *Colletotrichum Janiphae.*

It may here be mentioned that, though no specimens have been seen, *Phoma Lagenariae*, Sacc. (Syll. iii. 148) (*Sphaeropsis Lagenariae*, Thüm.) is according to the description merely a young state of some *Diplodia*, and the same guess might be hazarded for *Phoma Citrulli*, Berk. & Curt., and for *Phoma seminalis*, Sacc.; in fact all three may be the same species. But, to show the danger of such methods, it should be noticed that, in the same way, and apparently on equally good grounds, one might have conjectured that *Phoma Lagenariae*, Cooke was the same as *Phoma cucurbitalis*, Berk. & Curt., and this conjecture would have been wrong.

SPECIES TO BE TRANSFERRED TO COLLETOTRICHUM.

833. **Phoma Janiphae,** *Sacc.*

COLLETOTRICHUM JANIPHAE, *Grove.*

Sphaeropsis Janiphae, Thüm. in Flora, 1878, p. 179.
Macrophoma Janiphae, Berl. & Vogl. in Syll. Addit. p. 307.

Pustules densely gregarious, very numerous, sub-epidermal, black, paler in the centre, roundish or subangular, nearly flat, usually 150–180 μ diam., each with a few (20–25) blackish bristles arranged round the periphery or rarely scattered over the disc; bristles short, curved or straight, tapering slightly upwards, rarely septate, dark olivaceous-brown, 30–40 μ long. Spores oval or oblong, rounded at both ends, with one or more guttules, quite hyaline, 10–13 × 4–5 μ; sporophores erect, fasciculate, oblong, cuspidate at apex, pale-brown, 12–14 × 4–5 μ. (Fig. 6, *c.*)

On dead stems of *Jatropha Janipha* (*Manihot carthaginensis*), Aiken, South Carolina (Thüm. Mycoth. univ. no. 1191!), legit Ravenel.

The black *Phoma*-like appearance, which Thümen so mistakenly describes, is due to the coloured sporophores and subhymenium; the black margin is due to the bristles. When the epidermis is raised in the centre, it shows as a whitish dot on the black pustule, and ultimately bursts at that point. When the pustule is older, the disc becomes quite pale, but is still surrounded by a narrow black border due to the bristles.

Roumeguère (Fung. Gall. exs. no. 718!) issued a similar fungus, from Collioure, in France, which shows pustules of two sizes. The larger appear to be merely an immature state of the *Colletotrichum*, before the bristles are developed or the spores have reached their proper shape and size. But what the smaller are, unless they are the same thing in a still earlier state (as seems probable), I do not care to pronounce: they have spores, some about 5 × 3 μ, as Saccardo says (f. *microspora*, Syll. 141), but they are very variable, usually a sign of immaturity.

In a paper, which it is hoped will soon be published in this Bulletin, I have shown that *Colletotrichum* and *Vermicularia* should be kept as two distinct genera of Melanconiales, separated by the fact that in *Vermicularia* the bristles are the most conspicuous part and are often well-developed before the spores appear; while in *Colletotrichum* the reverse is the case, the bristles being as it were an afterthought, developed only as the pustule matures, so that fully-formed spores are often plentifully produced before a single bristle can be detected.

A few other species, listed by Saccardo, may now be more briefly referred to:—

841. **Phoma irregularis,** *Sacc.*

Sphaeropsis irregularis, Berk. & Curt. Cub. Fung. no. 563.

This name should be dropped: the type specimen (Herb. Berk.

no. 789!) yielded various irregular spores, but none like those described. Berkeley sketched some "spores" on the sheet, it is true, from which the account may be taken, but they do not look like real spores, and in the absence of all knowledge of the host the fungus can never be recognised again.

853. **Phoma minutissima,** *Cooke.*

Asteroma Liatridis, Berk. & Curt. in Herb.

This specimen, on leaves of *Liatris odoratissima,* South Carolina (*Ravenel,* no. 1920!), consists of a dematioid mycelium, chiefly on the upper side of the leaf, forming greyish-black oblong or oval patches, 10–11 mm. across, often confluent into large irregular blotches and dotted over with innumerable little black lumps of mycelium which are the beginnings of pycnidia or perithecia, but in which no spores could be found anywhere, although there is ample material. It cannot be recognised unless one should find it again, with the same external facies and on the same host, in a more advanced state. Meanwhile, if it is worth keeping in memory, *Asteroma Liatridis* B. & C. is the correct name: it is certainly no *Phoma.*

861. **Phoma Violae,** *Westd.*

The pycnidia in Westd. Crypt. Belg. no. 525! on examination are seen to be situated in sori of *Puccinia Violae* containing both uredo and teleutospores. They have exactly the same structure and texture as *Darluca Filum,* Cast., but produced no real spores, though the contents appear to be what Westendorp described as "spores." The fungus is evidently the *Darluca,* immature, and with the cavity filled with subsclerotioid tissue.

895. **Phoma arctica,** *Sacc.*

Sphaeropsis arctica, Berk. & Curt. in Proc. Amer. Acad. Arts, Sci. iv. 1858, p. 125, no. 124.

Pycnidia few, scattered, erumpent, convex, black, irregular in shape, often compressed. Spores numerous, fusoid, acute at both ends, hyaline, often biguttulate, straight in front view, curved and narrower in profile, 10–12·5 × 1–2 μ; sporophores straight, linear, hyaline, 7–8 μ long.

On outer surface of cone-scales of *Picea ajanensis,* Fisch. ex Trautvetter & Meyer. Kamtchatka (Herb. Berk.). The host was wrongly given in the original description as "*Pinus ajanensis.*"

Neither a true *Phoma,* nor a *Phomopsis.* Pycnidial wall minutely parenchymatous, opening in the upper half. It is most likely that this is a form or variety of *Sporonema strobilinum,* Desm., the spores being very similar to those of that species. But the material is too small in quantity for perfect certainty.

903. **Phoma brunneotincta,** *Berk. & Curt.*

Berkeley gave the name *Phoma brunneotincta* to specimens in his herbarium on a Sweet Chestnut (*Castanea*) from New England. Cooke gave the same name to a fungus which grew on the inside of a dead husk of Horse Chestnut (*Aesculus*) in Kew Gardens,

thinking they were the same. But the Kew specimens are a *Phomopsis*, and probably identical with one of the species known to occur on *Aesculus*. Since Berkeley's New England specimen is very small in quantity, and he seems to have published no description, while Cooke's description in Grevillea (xvii. 42) is apparently a compound of the two sets of specimens (for its spores are not those of the Kew fungus), it would be better to drop the name altogether.

In the vain endeavour to decide to which of the species of *Diaporthe* on *Aesculus* the Kew fungus should be assigned, it was thought well to examine *D. aesculicola*, Cooke, *D. Hippocastani*, Cooke, and *Cryptospora Aesculi*, Fckl. The examination showed clearly that these three species, which were represented by authentic specimens, are all identical. All three are accompanied by *Septomyxa Aesculi*, Sacc., the C-spores of the *Diaporthe;* but in the first the ascophorous stage predominates, in the second the pycnidial stage, and so they present different aspects by which Cooke was misled, while Fuckel's is merely the young state before the septum of the ascospores is developed. The species should be called *D. Hippocastani* (Cooke), since that is the earliest name to which a correct description was appended.

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XXXIII.—MISCELLANEOUS NOTES.

Dr. J. G. Baker.—The honorary degree of D.Sc., has been conferred by the University of Leeds upon Mr. J. G. Baker, F.R.S., late Keeper of the Herbarium and Library.

To fill the vacancy created in the post of Assistant for India in the Herbarium at Kew by the transfer of Mr. J. Hutchinson (p. 236), the Secretary of State for India in Council has re-appointed, temporarily, Mr. S. T. Dunn, B.A., F.L.S., who occupied the post from 1st April, 1901, to 21st February, 1903.

We learn that Mr. R. S. Troup, Assistant Inspector General of Forests, India, has been elected Professor of Forestry in the University of Oxford.

We learn that Mr. H. R. Jones, a student in the Imperial College of Science, has been appointed Mycologist to the Ministry of Agriculture, Egypt.

We learn that Mr. H. B. Sharpe, a former member of the gardening staff at Kew, and for some time Plant Import Inspector in the East Africa Protectorate, has been appointed by the Secretary of State for the Colonies an Assistant District Commissioner in the East Africa Protectorate.

We learn that Mr. Alec Holm, Under-Secretary to the Ministry of Agriculture, Union of South Africa, and lately in charge of the Experimental Farm, Potchefstroom, has been appointed by the Secretary of State for the Colonies Director of Agriculture, East Africa Protectorate.

The following appointments have been made by the Secretary of State for the Colonies on the recommendation of Kew:—

East Africa Protectorate:—

Mr. W. H. Birchenough, to be Tropical Agricultural Instructor.

Messrs. F. B. Butler and J. Sparrow, members of the gardening staff at Kew, to be Agricultural Instructors.

Mr. C. B. Ussher, formerly a member of the gardening staff at Kew, to be Horticulturist.

Uganda:—

Messrs. P. Chandler and C. Hazel, members of the gardening staff at Kew, to be Assistant District Agricultural Officers.

Nyasaland:—

Messrs. A. M. Henderson, T. J. Shaw and D. Prain, to be Agriculturists in the Department of Agriculture.

Gold Coast:—

Mr. W. C. Fishlock, formerly a member of the gardening staff at Kew, and for several years Curator of the Botanic Station in the Virgin Islands, to be a Senior Curator in the Department of Agriculture.

Nigeria (Southern Provinces):—

Mr. T. Laycock, formerly Agricultural Inspector, to be Mycologist in the Department of Agriculture.

Mr. G. R. Pierez, to be an Assistant Superintendent in the Department of Agriculture.

Ceylon:—

Lt.-Col. F. Summers, R.E., to be Economic Botanist in the Department of Agriculture.

Federated Malay States:—

Mr. F. de la Mare Norris, Assistant Agricultural Inspector, to be Assistant to the Director of Agriculture.

Mr. W. N. C. Belgrave, B.A., Assistant Mycologist, to be Plant Physiologist in the Department of Agriculture.

Mr. B. Bunting, Assistant Agriculturist, to be Agriculturist in the Department of Agriculture.

Mr. H. H. Stirrup, M.Sc., Assistant Agricultural Inspector, to be Assistant Mycologist in the Department of Agriculture.

Mr. W. N. Sands, F.L.S., formerly a member of the gardening staff at Kew, and since 1899 Agricultural Superintendent in St. Vincent, West Indies (*K.B.*, 1899, 133), to be Assistant Economic Botanist in the Department of Agriculture.

Mr. F. Birkinshaw, Agricultural Instructor, Department of Agriculture, Mauritius (*K.B.*, 1914, 227), a former member of the gardening staff at Kew, and for some time Assistant Agricultural Superintendent, St. Vincent (*K.B.*, 1912, 350), to be Assistant Agricultural Inspector in the Department of Agriculture.

St. Vincent:—

Mr. T. Jackson, formerly a member of the gardening staff at Kew, and since 1905 Curator of the Botanic Station, Antigua (*K.B.*, 1905, 60), to be Agricultural Superintendent in succession to Mr. Sands.

British Guiana:—

Mr. G. E. Bodkin, B.A., Economic Biologist, to be Assistant Director of the Department of Science and Agriculture.

Mr. F. Stell, of the Imperial College of Science and Technology, to be Mycologist in the Department of Science and Agriculture.

Mr. J. C. Moore.—We regret to learn of the retirement through ill-health of Mr. J. C. Moore, Agricultural Superintendent, Grenada. Mr. Moore entered Kew as a young gardener in 1893. In 1895 he was appointed Curator of the Botanic Station, St. Lucia, and in 1914 was transferred to the position he has now vacated.

Mr. R. Irwin Lynch.—After a term of close upon forty years' service as Curator of the Botanic Gardens at Cambridge, Mr. Lynch has recently retired. He entered Kew, as a young gardener, February 11th, 1867; was made foreman of the Herbaceous Department in August, 1870, and foreman of the Propagating Department in March, 1871. He left Kew in July, 1879, to take up his post at Cambridge. He was made an Associate of the Linnean Society in 1881; Veitch Medallist in 1901; Hon. M.A. (Cantab.) and Victoria Medallist in 1906. Apart from his work at Cambridge, his most important service to horticulture probably has been the improvement he effected in Gerberas by selection and hybridization. The race he established is now largely cultivated in trade establishments on the French Riviera. Mr. Lynch is now residing at Torquay.

Taxotrophis and Balanostreblus.—To the introductory statement which precedes the revision by Mr. Hutchinson of these two genera (*K.B.* 1918, p. 147), should be added the information that the opportunity afforded of examining the material upon which the genus *Balanostreblus* was originally based by Kurz was the result of an independent investigation by Mr. J. S. Gamble of the relationship between these two genera. This investigation was undertaken at the suggestion of the late Mr. J. H. Lace, at whose instance the material of *Balanostreblus*, Kurz, including that of the plant to which, as the notes published in 1918 show, that author's name must now be restricted, appears to have been dispatched to Mr. Gamble.

Peace Commemoration Trees at Kew.—In the autumn of 1917 some seeds of common oak and of horse-chestnut were received at Kew which had been collected on the battlefields of Verdun. They had been sent by the Mayor of that city to the London and North Western Railway, whose officials forwarded a few of each kind to Kew. The seeds were sown and twenty-one oaks and eight horse-chestnuts were raised from them.

In view of their interesting origin these trees appeared very appropriate to plant as memorial trees. Accordingly three of them, two oaks and one chestnut, which had been established in pots for the purpose, were planted on Peace Day, July 19th, 1919—the day of the Great Victory Procession in London. Two of them are on the southern slope of the hill which is crowned by the Temple of Aeolus, the other is between No. I. Museum and the Temple of Arethusa. Considering the interest with which these trees are likely to be regarded by future generations, when the Great War has receded into the dim past, it seems desirable to put on record the time and place of their planting.

By desire of His Majesty the King, two of these oaks and two of the chestnuts were planted at Windsor on the same day. In the public parks at Reading, under the auspices of Messrs. Sutton, two oaks were also planted. A chestnut was sent to Keswick for the same purpose.

Nectaropetalum zuluense.—Recently a specimen of *Erythroxylon zuluense*, Schönl., from Ngoya Forest, Zululand, was received from Dr. E. P. Phillips, Pretoria, who suggested that it might be the same species as that described by the late Dr. Bolus as *Peglera capensis*, (Pegler 1269) and subsequently transferred by Dr. Stapf to *Nectaropetalum*, as *N. capense*. On examination it was found to be undoubtedly a species of *Nectaropetalum*, though differing from *N. capense* in the following points:—

1. The very obscure nervation of the upper surface of the leaves.
2. The length of the pedicels which measure from 5 to 8 mm. as compared with 2 mm. or less in *N. capense*.
3. The presence of a two-lobed pocket-like ligule, similar to that found in *N. Kaessneri*, Engl.

On the other hand it agrees with both *N. capense* and *N. Kaessneri* in its single style and bifid stigma, as opposed to the three (rarely four) free styles which are usual in *Erythroxylaceae*.

It resembles *Erythroxylon* in its striated, deciduous stipules

Explanation of text-figures of *Nectaropetalum zuluense*:—
1, flower; 2, petal from inside; 3, the same from outside; 4, stamens; 5, pistil; 6 and 7, fruit; 8, inside of pericarp; 9, section of seed:—all enlarged except No. 6.

and the presence of a well-defined appendage at the base of the lamina of each petal (fig. 2), though the appendage is much simpler than that of *Erythroxylon*, or at any rate of the African species of that genus.

So far the fruit of *Nectaropetalum* has not been known. A description of it is, however, supplied below from the material of the new species under discussion. It will supplement the original description of the genus.

Fructus siccus, indehiscens, ob loculum alterum vacuum collapsum specie 1-loculare; pericarpium chartaceum, intus costulis 3 notatum (fig. 8). *Semen* 1, testa membranacea; endospermium carnosum, mediocre. *Embryo* viscosus; cotyledones rotundato-ellipticae; radicula distincta.

The very great similarity of this fruit to that of typical *Erythroxylon* demonstrates clearly the close affinity of *Nectaropetalum* and *Erythroxylon* as pointed out by Dr. Stapf and Mr. Boodle in *Kew Bulletin*, 1909, p. 189.

Dr. Schönland's description in the Records of the Albany Museum being sufficiently explicit, there is no need of repeating it. It may suffice to state that, owing to its removal to *Nectaropetalum*, the name of the plant will have to be changed to *Nectaropetalum zuluense*, Corbishley. A. G. C.

The Flora of Macquarie Island.—In series C of the Scientific Reports of the Australasian Antarctic Expedition under the leadership of Sir Douglas Mawson during 1911–14, occurs one of singular interest from the pen of Mr. T. F. Cheeseman, on the Vascular Flora of Macquarie Island. This island lies over 600 miles to the south-west of New Zealand, about 920 miles south-east of Tasmania, and about 970 miles from the coast of the Antarctic continent. It lies in the same zone as South Georgia, some 5800 miles to the east, and as Kerguelen Island, 3250 miles to the east. Its greatest length is nearly 21 miles, its extreme width nearly four miles. Discovered in 1810 it was not until some 20 years later that anything was learned regarding its vegetation. About 1830 Mr. C. Fraser sent to Sir W. J. Hooker a small collection representing eight species of flowering plants which are duly recorded in Sir J. D. Hooker's 'Flora Antarctica.' As Mr. Cheeseman points out this small collection contained all but one of the conspicuous species in the vegetation of the island. Half-a-century later Dr. J. H. Scott, of Otago University visited the island to study its fauna and flora. His account of the island, published in 1883, includes a list of the plants, determined by Mr. A. C. Purdie, and Mr. Cheeseman after a critical revision of the list, finds that the number of species recorded had been raised from eight to nineteen. Another visit to the island was paid by Mr. A. Hamilton, of Otago University, fourteen years later. Mr. Hamilton's notes published in 1895, include a list of the plants determined by Mr. T. Kirk, which brings the total number of species up to thirty-two, three of which are naturalised species, while three others were regarded as endemic ones. The decision of Sir D. Mawson to make Macquarie Island

a subsidiary base for his Antarctic Expedition, enabled the making of arrangements for a systematic survey of the island and the investigation of the vegetation was, during 1911–14, entrusted to Mr. H. Hamilton, son of the distinguished biologist, who had previously visited the island in 1894. His collection includes all but two of the species obtained by Dr. Scott in 1880, and by his own father in 1914, a defect more than compensated for by the addition of four species, one of them an endemic species, not previously recorded from Macquarie Island. Mr. Cheeseman's catalogue of the species thus includes thirty-four vascular plants, of which three are finally pronounced to be endemic. Of the remaining thirty-one, fifteen, or practically one-half are common to the 'ring or zone of widely separated lands surrounding the Antarctic continent within the parallels 45° S. to 60° S.'' All but four are found in the subantarctic islands of New Zealand; eighteen of the thirty-four extend to New Zealand proper, and eleven are found in no other country. Having regard to the relative proximity of the island to New Zealand these latter facts and figures are not surprising. But the fact that twelve of the species occur in Fuegia, and that of these six should also occur in South Georgia, while eleven occur in Kerguelen—one species that Macquarie shares with Kergulen does not extend to Fuegia, two species that Macquarie shares with Fuegia do not occur in Kerguelen—calls for further consideration.

After carefully reasoned examination of the circumstances involved, Mr. Cheeseman reaches the following conclusions. The existing flora of Macquarie Island does not date further back than the close of the last glacial epoch. Since then the history of that flora, save as regards its three endemic species, has been one of plant-migration, mainly from the New Zealand outlying islands, but in some cases from the far distant Kerguelen group. If, however, Macquarie Island existed in early Tertiary times when Antarctica possessed a luxuriant flora and when in all probability geographical and climatic features co-operated in facilitating intercourse between Antarctica and the New Zealand area, the position of the island would have given it an important place in a chain of plant-migrations extending from Chile to Antarctica and from Antarctica to the north of New Zealand. Traces of such a chain are still evident in the floras of both New Zealand and South America. D. P.

Flora of Aldabra.—In a paper on the Flora of Aldabra in the *Kew Bulletin*, 1919, reference is made on p. 114 to a collection of plants from the Seychelles, Aldabra and Assumption *made by Mr. Walter Fox*. We now learn that this statement was based on a misunderstanding, and that the collection was *actually made by Mr. P. R. Dupont*, the energetic Curator of the Botanic Station, Seychelles, who on his return from a three months' tour in Aldabra and the neighbouring islands entrusted it to Mr. Fox, then just leaving for England. Mr. Fox delivered the collection personally at Kew, where, owing to some misunderstanding, and the absence of signed labels, it was taken to be the result of an

excursion of his own. Mr. Fox did not visit the Aldabra group of Islands, so that *throughout the paper the name* DUPONT *should be substituted for* FOX *wherever the latter occurs.*

Root Disease in Sugar Cane.—An interesting Report by Mr. W. Nowell, Mycologist of the Imperial Department of Agriculture, West Indies, is printed in Bulletin vol. xvii., Part 2 of the Department of Agriculture, Trinidad and Tobago, and in the June number of the Proceedings of the Agricultural Society of Trinidad on his visit paid to Trinidad to investigate the disease known as "blight" in the sugar cane fields. This trouble had been attributed to froghopper infestations, but the Entomologist in charge did not feel satisfied that the insect trouble was wholly or always responsible. Mr. Nowell found that a root-disease was generally present in unhealthy fields, and its prevalence was proportionate to the severity of the damage. This condition is induced by the invasion of the roots, the underground portions of the stool, and the young shoots by the mycelium of certain fungi that are generally saprophytic on the decaying cane material. Both the onset and the persistance of root-disease depend on a condition of weakness or debility in the cane.

It is stated that when root-disease attacks the plants the effect is that of shortage of water, the edges of the leaves curling up and the plant gradually turning brown. The stool has a characteristic stunted appearance, many shoots being dead and dry, and the trash firmly cemented around the lower joints of the cane. The system of continuous cropping, of long ratooning, of planting between the old rows, and turning the old and dead stools full of root fungus on to the new young plants, all tends to give every chance to the fungus to induce disease. Any conditions such as lack of manure, lack of moisture, lack of tilth or attacks by froghopper that weaken the plant, are contributory factors to the severity of cane blight.

Mr. Nowell points out that the parasitism of the two fungi, *Marasmius sacchari*, and an *Odontia*-like species, that are alleged to cause cane blight is in need of thorough investigation, and that the whole question of attack in the case of potential parasites is inseparably bound up with the general health of the plant, and with questions of good cultural methods. N. L. A.

Fruit Culture in Malaya.*—In a preface to this Bulletin by the Director of Agriculture it is stated that it "is issued in the hope that it will encourage and assist the planting of fruit trees in private gardens, particularly on estates. At present a very small proportion of gardens in the country contain anything approaching a good selection of fruit trees, and most residents depend on what can be bought in the local market." Early introduction of exotic fruits into the Peninsula was brought

* Bulletin No. 29, 1919, of the Department of Agriculture, Federated Malay States, by J. N. Milsum, Superintendent, Government Plantations, Selangor and Negri Sembilan.

about by travellers visiting the important port of Malacca, and the first records of what was cultivated date from the close of the sixteenth century, when the Portuguese were established in Malacca. During the last century valuable introductions have been made through the Botanic Gardens of Singapore and Penang. In 1908 special attention was being given to the cultivation of fruits at the Kuala Lumpur Experimental Plantation, and in 1915 a Fruit Nursery was opened at the Batu Tiga Plantation, Selangor. It is unfortunate that the production of fruit for sale in the local markets has steadily declined with the rise of other industries, notably *Hevea* planting, since many of the large plantations of fruit trees in existence towards the close of the past century in Singapore, Malacca and elsewhere, have been abandoned. This is a matter for regret, as about 30 years ago (see *Kew Bulletin*, 1888, "Principal Fruits grown in the Straits Settlements," pp. 250–252) there was a good foundation for development. It was then recorded that "the supply of fruit is now sufficient for local wants. All the important fruits would be produced in much larger quantities if there were a market for them." At the time of the *Kew Bulletin* paper, the fruits exported in a fresh state to neighbouring countries were mainly "Mangosteens" (*Garcinia Mangostana*), "Pine-apples" (*Ananas sativa*), "Durians" (*Durio zibethinus*), "Rambutans" (*Nephelium lappaceum*). Fruits exported in a preserved state were Pine-apples in considerable quantities to Europe, China, India, etc. (340,000 tins in 1887), Mangosteens (20,000 tins), chiefly to Europeans homeward bound, and 15,000 tins of Guava jelly, Pine-apple jam, and Bread-fruit, chiefly to Europeans homeward bound. In reference to the Pine-apple industry it may be of interest to note what was said of the Singapore produce at the Colonial and Indian Exhibition in London, 1886 (see Morris, "Reports on the Colonial Sections of the Exhibition," 1887, p. 140), "The chief place is taken by the Pine-apples of Singapore, which, preserved whole in syrup, have entered into commerce and are now regularly supplied by London Stores. The Pine-apple is canned and shipped in a similar manner from the Bahamas, Fiji and Natal; but the Singapore Pine-apple has established itself as one of the best in the market." In the Bulletin under consideration it is stated that "no fruit appears to have been grown on a large commercial scale with the single exception of the Pine-apple, of which the cultivation for canning did not assume any importance until about 1890, when the Chinese commenced the business. Large areas of land in Singapore, formerly under Pepper, Indigo and Gambier cultivation were utilised for the production."

The author does well by encouraging a similar standard all round, and especially so by keeping in view the improvement of the local supply. There are seven chapters dealing with the past and present position of Fruit Cultivation in the Malay Peninsula, Propagation, Cultivation, Soil, Pests and Diseases, Native and Exotic Fruits, included, with a good index, in 108 pages, and illustrated with 23 plates. J. H. H.

Viburnum Carlesii, var. **syringiflora.**—In the Gardeners' Chronicle for December 6th, 1919, p. 285, Mr. E. H. Wilson points out that the plant described under this name in the *Kew Bull.* 1919, p. 239, is the same as *Viburnum bitchiuense*, Makino. This species had not hitherto been represented in the Kew Herbarium, and its publication was unfortunately overlooked. It had been grown in English gardens for several years as *V. Carlesii*, and was assumed to be, like the true form of that species, a Corean plant. According to Mr. Wilson, we now know that it is a native of the mountains of the province of Bitchiu in Western Japan, where it was discovered some time prior to 1902 and named by Makino. This botanist, however, in 1909 changed his mind and identified it with *V. Carlesii*, Hemsl., thereby causing some confusion and disappointment. Mr. Wilson states that a Japanese Nursery Company, relying on Mr. Makino's conclusions, obtained the Japanese plants, propagated and exported them as *V. Carlesii*, and it was only when complaints of their inferior quality began to reach them that suspicion was aroused and the mistake discovered. J. H.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX I.—1919.

LIST OF SEEDS OF HARDY HERBACEOUS PLANTS AND OF TREES AND SHRUBS.

The following is a select list of seeds of Hardy Herbaceous Plants and of Hardy Trees and Shrubs which, for the most part, have ripened at Kew during the year 1918. These seeds are available only for exchange with Botanic Gardens, as well as with regular correspondents of Kew.

HERBACEOUS PLANTS.

Abronia arenaria.

Acaena glaucophylla.
macrostemon.
microphylla.
myriophylla.
Novae-Zelandiae.

Achillea ageratifolia.
argentea.
Clavennae.
Gerberi.
Kellereri.
macrophylla.
tomentosa.
Wilczeckii.

Aciphylla Colensoi.

Aconitum barbatum.
gymnandrum.
Kusnezoffi.
leptanthum.
Lycoctonum.
luridum.
moldavicum.
palmatum.
uncinatum.
Wilsoni.

Actaea alba.
arguta.

Adenophora ornata.
stylosa.

Adenostyles viridis.

Adonis amurensis.

(137.) Wt. 196—794. 1,125. 12/18. J. T. & S., Ltd. G. 14. Sch. 12.

Aethionema amoenum.
cappadocicum.
cordatum.
pulchellum.

Agrostis alba.

Allium atropurpureum.
giganteum.
kansuense.
karataviense.
macranthum.
neapolitanum.
odorum.
polyphyllum.
pulchellum.
Schuberti.
scorzonerifolium.
siculum.
subhirsutum.
Tubergeni.

Alonsoa linifolia.
Warscewiczii.

Alstroemeria aurantiaca.
Ligtu.

Althaea armeniaca.
cannabina.
ficifolia.
kurdica.
pallida.
rosea.

Alyssum amanum.
creticum.
incanum.
montanum.
podolicum.
saxatile.
serpyllifolium.
sinuatum.
spinosum.

Amarantus caudatus.
chlorostachys.
hypochondriacus.
polygamus.
retroflexus.

Amphicarpaea monoica.

Anacyclus officinarum.

Androsace albana.
brigantiaca.
coccinea.
lanuginosa.
primuloides.
villosa.

Andryala Agardhii.

Anemone alpina.
decapetala.
multifida.
pratense.
Pulsatilla.
rivularis.
sulphurea.
sylvestris.
vitifolia.

Anemonopsis macrophylla.

Anthemis macedonica.
montana.
tinctoria.

Anthericum Liliago.
ramosum.

Antirrhinum hispanicum.
Orontium.

Aplopappus croceus.

Aquilegia Bernardi.
chrysantha.
coerulea.
flabellata.
glandulosa.
pyrenaica.
truncata.

Arabis arenosa.
bellidifolia.
petraea.
verna.

Arenaria cephalotes.
foliosa.
glandulifera.
gypsophiloides.
grandiflora.
montana.
pinifolia.
purpurascens.
sajanensis.

Argemone alba.
mexicana.

Arisarum proboscideum.

Armeria canescens.
chilensis.
fasciculata.
majellensis.

Arnica latifolia.
longifolia.
montana.
sachalinensis.

Asperula azurea.
galioides.

Asphodeline lutea.

Asphodelus albus.

Aster alpinus.
Glehni.
himalaicus.
lichiangensis.
Lipskyi.
oreophilus.
sericeus.
subcoeruleus.
vestitus.
yunnanensis.

Astilbe chinensis.
rivularis.
simplicifolia.
Thunbergii.

Astragalus arcticus.
chinensis.
frigidus.
pentaglottis.
stipulatus.
xiphocarpus.

Astrantia helleborifolia.

Athamanta Matthioli.

Atropa Belladonna.

Barbarea arcuata.

Beckmannia erucaeformis.

Bellium bellidioides.

Berkheya purpurea.

Biscutella ciliata.
didyma.

Bocconia cordata.

Brachypodium caespitosum.
japonicum.

Brassica campestris.
Erucastrum.
juncea.
napus var. dichotoma.
rugosa.
Tourneforti.

Brickellia grandiflora.

Briza maxima.
minor.

Bromus ciliatus.
japonicus.
maximus.
rubens.
squarrosus.
unioloides.

Bulbinella Hookeri.

Buphthalmum salicifolium.

Bupleurum falcatum.
longifolium.
sachalinense.

Caccinia strigosa.

Calamagrostis Epigeios.

Calandrinia speciosa.

Callirhoë pedata.

Callistephus hortensis.

Camassia Fraseri.
Leichtlinii.
montana.

Camelina sativa.

Campanula barbata.
bononiensis.
Cervicaria.
colorata.
Imeretina.
Kolenatiana.
lactiflora.
lanata.
latifolia.
latiloba.
longistyla.
macrostyla.
patula.
phyctidocalyx.
primulaefolia.
pulla.
rhomboidalis.
serotina.
speciosa.
thyrsoides × spicata.

Capsella grandiflora.

Carbenia benedicta.

Carduus tenuiflorus.

Carex binervis.
laevigata.

Carum copticum.

Catananche coerulea.

Cathcartia villosa.

Celmisia grandiflora.
holosericea.
spectabilis argentea.

Centaurea axillaris.
dealbata.
montana.
rupestris.

Centranthus Sibthorpii.

Cephalaria radiata.

Cerastium Biebersteinii.
macranthum.
tomentosum.

Chaerophyllum aromaticum.
nodosum.

Charieis heterophylla.

Chelone Lyoni.
obliqua.

Chenopodium ambrosoides.
capitatum.
urbicum.

Chlorogalum pomeridianum.

Chorispora tenella.

Chrysanthemum carinatum.
caucasicum.
cinerariaefolium.
coronarium.
corymbosum.
Haussknechtii.
pallens.

Cimicifuga cordifolia.
foetida.

Clarkia elegans.
pulchella.

Clematis Stanleyi.

Cnicus Eriophorum.
syriacus.

Collinsia bicolor.

Convolvulus undulatus.

Coriandrum sativum.

Coronilla minima.

Corydalis capnoides.
lutea.

Cosmidium Burridgeanum.

Craspedia alpina.

Crepis aurea.
blattarioides.
grandiflora.
pygmaea.
rubra.

Crocus asturicus.
medius.

Crucianella aegyptiaca.

Cynoglossum nervosum.

Dactylis altaica.

Dahlia variabilis.

Delphinium aconiti.
caucasicum.
decorum.
Delavayi.
elatum.
Geyeri.
grandiflorum.
Maackianum.
Menziesii.
occidentale.
pictum.
speciosum.
— var. glabratum.
vestitum.

Deschampsia caespitosa.
tenella.

Deyeuxia Langsdorfii.

Dianthus arenarius.
Armeria.
caesius.
capitatus.
Caryophyllus.
cruentus.
deltoides.
fragrans.
frigidus.
gallicus.
giganteus.
leptopetalus.
neglectus.
pallidiflorus.
petraeus.
Seguieri.
squarrosus.
subacaulis.
superbus.
viscidus.
Waldsteinii.

Dictamnus albus.

Digitalis ambigua.
lanata.

Dimorphotheca hybrida.
pluvialis.

Dodecatheon frigidum.
Meadia.

Draba aizoides.
Bertolonii.
carinthiaca.
fladnizensis.
frigida.
incana.
nivalis.
rigida.
Salomonii.
surculosa.

Dracocephalum nutans.
parviflorum.

Dryas Drummondii.
lanata.

Encelia calva.

Epilobium crassum.
Dodonaei.
luteum.

Epipactis palustris.

Eragrostis abyssinica.

Eranthis cilicica.

Eremostachys laciniata.

Eremurus himalaicus.
robustus.

Erigeron alpinus.
aurantiacus.
glabellus.
grandiflorus.
multiradiatus.
salsuginosus.
uniflorus.

Erinus alpinus.

Erodium amanum.
Botrys.
macradenum.
trichomanefolium.

Eryngium alpinum.

Erysimum rupestre.

Eschscholzia caespitosa.
californica.
Douglasii.

Eucharidium concinnum.

Farsetia eriocarpa.

Festuca Myuros.
rigida.

Fragaria indica.

Francoa appendiculata.
ramosa.

Fritillaria citrina.
Stracheyi.

Galactites tomentosa.

Galega orientalis.
patula.

Galium thymifolium.

Gastridium australe.

Gaultheria trichophylla.

Gaudinia fragilis.

Gentiana asclepiadea.
crassicaulis.
Cruciata.
dahurica.
decumbens.
Elwesiana.
Freyniana.
lutea.
macrophylla.
phlogifolia.
septemfida.
sikkimensis.
straminea.
stylophora.
tibetica.

Geranium albiflorum.
Donianum.
Fremonti.
grandiflorum.
ibericum.
incisum.
rivulare.
sessiliflorum.
tuberosum.

Gerbera Anandria.

Geum bulgaricum.
chiloense.
Heldreichii.
montanum.
triflorum.

Gilia achilleaefolia.
aggregata.
androsacea.
capitata.
micrantha.
multicaulis.
tricolor.

Glaucium corniculatum.
flavum var. tricolor.

Globularia incanescens.
vulgaris.

Glyceria distans.

Grindelia cuneifolia.
robusta.

Gypsophila elegans.
Steveni.

Halenia elliptica.

Hastingsia alba.

Hedysarum esculentum.
flavescens.
Semenovii.

Helianthemum canum.
Tuberaria.

Helichrysum Stoechas.

Helipterum roseum.

Heloniopsis japonica.

Hemiphragma heterophylla.

Herbertia pulchella.

Hesperis matronalis.

Heuchera Drummondi.

Hibiscus Trionum.

Hieracium alpinum.
Bornmülleri.
cappadocicum.
Heldreichii.
Jankae.
villosum.

Hilaria rigida.

Horminum pyrenaicum.

Hyacinthus azureus.
romanus.

Hymenophysa pubescens.

Hyoscyamus albus.
muticus.

Hypecoum procumbens.

Hypericum Coris.
linarifolium.
nummularium.
olympicum.

Hypochaeris glabra.

Iberis Amara.
Lagascana.
Tenoreana.

Incarvillea Delavayi.
grandiflora.

Inula ensifolia.
Hookeri.
macrocephala.
orientalis.
racemosa.
Royleana.

Iris aurea.
Bulleyana.
Clarkei.
chrysographis.
Delavayi.
dichotoma.
Forrestii.
laevigata.
longipetala.
setosa.
tenax.

Isatis glauca.

Jasione perennis.

Juncus alpinus.
Chamissonis.

Jurinia cyanoides.

Kitaibelia vitifolia.

Koeleria phleoides.

Lactuca perennis.

Lallemantia canescens.
peltata.

Lathyrus angulatus.
Aphaca.
cirrhosus.
cyaneus.
laxiflorus.
luteus.
maritimus.
Nissolia.
Ochrus.
pisiformis.
polyanthus.
pubescens.
rotundifolius.
setifolius.
tingitanus.
tuberosus.
undulatus.
variegatus.
venosus.

Laurentia tenella.

Lavatera cachemiriana.

Leontopodium alpinum.

Leptarrhena amplexifolia.

Leptosyne Douglasii.
maritima.
Stillmanni.

Leuzea conifera.
longifolia.

Ligusticum pyrenaicum.
scoticum.

Lilium giganteum.

Limnanthes alba.

Linaria aparinoides.
bipartita.
maroccana.
multipunctata.
saxatilis.
triphylla.
tristis.
viscida.

Linum nervosum.
usitatissimum.

Lotus Tetragonolobus.

Lunaria annua.

Lupinus concinnus.
micranthus.
mutabilis.
nanus.
pubescens.

Luzula Hosti.
nivea.

Lychnis chalcedonica.
Lagascae.
Preslii.
Sartori.

Lycurus phleoides.

Madia elegans.

Malope trifida.

Malva Alcea.
oxyloba.
parviflora.

Meconopsis aculeata.
cambrica.
heterophylla.
paniculata.
Prattii.
simplicifolia.
Wallichii.

Medicago Murex.
orbicularis.
turbinata.

Melica altissima.
ciliata.

Mirabilis divaricata.
Jalapa.

Monolepis trifida.

Muscari armeniacum.
compactum.
neglectum.
paradoxum.
parviflorum.
pulchellum.

Myosurus minimus.

Nardus stricta.

Neja gracilis.

Nicandra physaloides.

Nicotiana rustica.
Sanderae.
Tabacum.

Nigella corniculata.
damascena.

Oenothera acaulis.
densiflora.
rosea.
tenella.
triloba.

Omphalodes linifolia.

Orchis foliosa.

Ornithogalum arcuatum.
narbonense.

Oxytropis baicalensis.
ochroleuca.
pilosa.

Paeonia anomala.
Emodi.
paradoxa.
Veitchii.

Panicum capillare.

Papaver Argemone.
commutatum.
glaucum.
laevigatum.
lateritium.
orientale.
pavoninum.
rupifragum.
somniferum.

Paradisia Liliastrum.

Patrinia heterophylla.
palmata.

Pentstemon acuminatus.
alpinus.
arizonicus.
barbatus.
campanulatus.
confertus.
deustus.
diffusus.
glaber.
glaucus.
gracilis.
heterophyllus.
humilis.
Jamesii.
laevigatus.
Lobbi.
Menziesii var. Scouleri.
ovatus.
secundiflorus.

Phleum arenarium.
asperum.
Michelii.

Phlomis pratensis.
tuberosa.
umbrosa.

Physalis Alkekengi.
Bunyardi.
Francheti.

Physochlaina orientalis.

Physospermum cornubiense.

Physostegia virginiana.

Phyteuma Michelii.
orbiculare.
Scheuchzeri.
spicatum.

Phytolacca acinosa.
decandra.

Pimpinella Anisum.

Plantago Candollei.
Coronopus.
Cynops.
maritima.
Myosurus.
Psyllium.

Platycodon grandiflorum.
— var. Mariesii.

Pleurospermum Golaka.

Podolepis affinis.

Podophyllum Emodi.

Polemonium grandiflorum.
mexicanum.
pauciflorum.

Polygonum affine.
vacciniifolium.
viviparum.

Polypogon littoralis.
monspeliensis.

Polypteris Hookeriana.

Portulaca grandiflora.

Potentilla argyrophylla.
calycina.
crinita.
dealbata.
fulgens.
glandulosa.
gracilis.
Herbichii.
Meyeri.
montenegrina.
Mooniana.
multifida.
nepalensis.
nevadensis.
pennsylvanica.
recta.
rivale.
rupestris.
sericea.
tanacetifolia.

Preslia cervina.

Primula Beesiana.
Bulleyana.
capitata.
Cockburniana.
darialica.
farinosa.
frondosa.
involucrata.
Kingii.
pseudo-sikkimensis
pulverulenta.
reticulata.
rosea.
saxatilis.
sinopurpurea.
Smithiana.
Stuartii.

Psoralea acaulis.
macrostachya.
physodes.

Pycnanthemum canceolatum.

Ramondia pyrenaica.

Ranunculus chaerophyllus.
falcatus.
nissanus.

Reseda virgata.

Rheum acuminatum.
nobile.
Ribes.

Rodgersia aesculifolia.
pinnata.
podophylla.
sambucifolia.

Roemeria hybrida.

Romulea candida.
speciosa.

Rudbeckia ampla.
amplexicaulis.
speciosa.
subtomentosa.

Rumex maximus.

Salvia argentea.
Bertolonii.
glutinosa.
Horminum.
Sclarea.
uliginosa.
verticillata.
virgata.

Santolina pinnata.

Saponaria Vaccaria.

Saussurea albescens.
hypoleuca.
salicifolia.

Saxifraga canaliculata.
cartilaginea.
cernua × granulata.
cochlearis.
— var. minor.
cordigera.
decipiens.
diversifolia.
granulata.

Saxifraga—*cont.*
Hausmanni.
Hirculus.
lingulata.
— var. lantoscana.
longifolia.
manshuriensis.
montavoniensis.
mutata.
nivalis.
pedemontana.
petraea.
rotundifolia.

Scabiosa candicans.
caucasica var. connata.
graminifolia.
gramuntia.
longifolia.
prolifera.
vestina.

Scilla autumnalis.
Lilio-hyacinthus.
messeniaca.
verna.

Scopolia lurida.
sinensis.

Sedum altissimum.
Ewersii.
heterodontum.
kamtschaticum.
maximum.
pilosum.
rhodanthum.
Semenovii.
spathulifolium.
ternatum.

Selinum serbicum.
vaginatum.

Senecio abrotanifolius.
adonidifolius.
alpinus.
Clivorum.
diversifolius.
Doronicum.
elegans.
Ledebouri.

Senecio—*cont.*
Ligularia.
Lyallii.
squalidus.
stenocephalus.

Serratula atriplicifolia.
Gmelinii.
quinquefolia.
tinctoria.

Seseli elatum.
glaucum.

Setaria glauca.
italica.

Sidalcea candida.
Listeri.
malvaeflora.
neo-mexicana.

Siderites scordiodes.

Silene alpestris.
asterias.
cretica.
fimbriata.
italica.
linicola.
longicilia.
melandrioides.
Muscipula.
noctiflora.
nocturna.
paradoxa.
pendula.
quadrifida.
Reichenbachii.
rupestris.
squamigera.
tenuis.
vallesia.
verecunda.
Zawadskii.

Silybum eburneum.

Sium sisarum.

Smyrnium Olusatrum.

Specularia pentagonia.
perfoliata.
Speculum.

Spiraea digitata.
palmata.

Stachys Alopecuros.
citrina.
graeca.
grandiflora.

Swertia dilatata.
Hookeri.
Kingii.
longifolia.
multicaulis.
perennis.

Symphyandra Hofmanni.
Wanneri.

Tanacetum Aucherianum.

Tellima grandiflora.

Thalictrum corynellum.
cultratum.
glaucum.
squarrosum.

Thermopsis fabacea.
lanceolata.

Thymus odoratissimus.

Trautvetteria palmata.

Trifolium elegans.
ochroleucum.
pannonicum.

Trigonella coerulea.
corniculata.
polycerata.
radiata.

Trillium grandiflorum.

Trollius altaicus.
asiaticus.
sinensis.
yunnanensis.

Trachymene pilosa.

Tricyrtis macropoda.

Tulipa australis.
dasystemon.
Kaufmanniana.
linifolia.

Ursinia pulchra.

Urtica pilulifera.

Valerianella carinata.
dentata.
echinata.
eriocarpa.
vesicaria.

Verbascum longifolium.
olympicum.
phoeniceum.

Verbena bonariensis.

Verbesina helianthoides.

Veronica austriaca.
fruticulosa.
gentianoides.
incana.
saxatilis.
spicata.
virginica.
— var. japonica.

Vesicaria utriculata.

Vicia angustifolia.
calcarata.
melanops.
pyrenaica.
unijuga.

Vincetoxicum fuscatum.

Viola cornuta.
persicifolia.

Xanthocephalum gymnospermoides.

Zygadenus elegans.

TREES AND SHRUBS.

Those marked with an asterisk were not grown at Kew.

*Abies Mariesii.
*sachalinensis.
*— var. nemorensis.
*umbellata.
*Veitchii var. olivacea.

Acanthopanax divaricatum.
sessiliflorum.
setchuenense.

Acer circinatum.
dasycarpum.
glabrum.
Heldreichii.
hyrcanum.
insigne.
Lobelii.
macrophyllum.
micranthum.
Miyabei.
monspessulanum.
neglectum.
nikoense.
opulifolium.
pennsylvanicum.
platanoides Reitenbachii.
tataricum.
tetramerum.
Trautvetteri.
Tschonoskii.

Actinidia arguta.

Aesculus indica.

Akebia lobata.

Alnus barbata.
cordifolia.
elliptica.
firma.
incana.
japonica.
mollis.
nitida.
oregona.
orientalis.

Alnus—*cont.*
serrulata.
sitchensis.
Spaethii.
tenuifolia.
viridis.

Amelanchier asiatica.
vulgaris.

*Amorpha canescens.

Aralia chinensis.
— var. pyramidalis.

Asimina triloba.

Berberis aggregata.
angulosa.
Aquifolium.
aristata.
Beaniana.
canadensis.
Chitria.
concinna.
consimilis.
Darwinii.
diaphana.
dictyophylla.
Edgeworthiana.
Francisci-Ferdinandii.
Gagnepainii.
Guimpelii.
Hookeri.
*integerrima.
japonica var. Bealei.
Lycium.
orthobotrys.
polyantha.
Prattii.
Sargentiana
Sieboldii.
sinensis.
Stapfiana.
subcaulialata.
thibetica.
Thunbergii.

Berberis—*cont.*
Tischleri.
umbellata.
Veitchii.
verruculosa.
virescens.
Wilsonae.
yunnanense.

Betula alaskana.
coerulea.
Ermani.
— var. nipponica.
fruticosa.
humilis.
japonica var. szechuanica.
kenaica.
lenta.
lutea.
Maximowiczii.
Medwediewii.
occidentalis.
papyrifera.
populifolia.
pumila.
utilis.
— var. Jacquemontii.

Bruckenthalia spiculifolia.

Buddleia albiflora.
japonica.
nivea.
variabilis.
— var. Veitchiana.

Callicarpa Giraldiana.
japonica.

Calycanthus floridus.
Mohrii.
occidentalis.

Camellia cuspidata.

Caragana ambigua.
arborescens.
— var. Redowskii.
aurantiaca.
Boisii.
decorticans.
frutescens.
microphylla.

Carmichaelia australis.
flagelliformis.

Carpinus caroliniana.
*cordata.
orientalis.
polyneura.

Cassinia fulvida.
Vauvilliersii.

Ceanothus americanus.
integerrimus.
papillosus.
thyrsiflorus.

Celastrus articulatus.
flagellaris.
scandens.

Celtis glabrata.
occidentalis.
Vilmoriniana.

Cephalotaxus drupacea.
Fortuni.
pedunculata.

*Cercis occidentalis.
Siliquastrum.

Chionanthus retusus.
virginica.

Cistus albidus.
crispus.
hirsutus.
*incanus.
laurifolius.
platysepalus.
populifolius.
salvifolius.
tauricus.

Cladothamnus pyrolaeflorus.

Cladrastis amurensis.

Clematis aethusifolia var.
latisecta.
akebioides.
alpina.
connata.

Clematis—*cont.*
— var. velutina.
Fargesii.
fusca.
Gauriana.
grata.
heracleaefolia.
integrifolia.
intermedia.
ligusticifolia.
mandshurica.
montana.
— var. rubens.
orientalis.
Pitcheri.
pseudo-flammula.
Rehderiana.
Scottii.
*Simsii.
Spooneri.
*Stanleyi (tender).
tangutica.
Veitchiana.
virginiana.

Clerodendron Fargesii.
trichotomum.

Clethra acuminata.
alnifolia.
—var. paniculata.
*canescens.
monostachya.

Colutea.
bullata.
longialata.
media.
orientalis.

*Convolvulus scoparius.

Cornus alba.
Amomum.
Bretschneideri.
candidissima.
circinata.
controversa.
glabrata.
macrophylla.
Mas.
Nuttallii.
officinalis.
pubescens.
Purpusi.
sanguinea.
stolonifera.

Corylopsis spicata.
Willmottiae.

Cotoneaster acutifolia.
— var. villosula.
affinis.
amoena.
apiculata.
applanata.
bacillaris.
— var. obtusata.
bullata.
buxifolia.
divaricata.
Fontanesii.
foveolata.
Franchetii.
frigida.
Harroviana.
Henryana.
horizontalis.
humifusa.
hupehensis.
laxiflora.
Lindleyi.
lucida.
microphylla.
moupinensis.
multiflora.
nitens.
Nummularia.
obscura.
pannosa.
pekinensis.
prostrata.
*racemiflora var. songorica.
rotundifolia.
salicifolia var. floccosa.
— var. rugosa.
Simonsii.
thymifolia.
tomentosa.
uniflora.
Zabelii.

Crataegus acclivis.
altaica.
basilica.
Beckwithae.
Boyntonii.
Buckleyi.
canadensis.
Carrierei.
coccinea.
cordata.
cuneata.
dilatata.
Downingii.
durobrivensis.
Ellwangeriana.
elongata.
foetida.
Forbesae.
georgiana.
glandulosa.
grigoniensis.
Henryi.
infera.
intricata.
Jonesae.
Lambertiana.
leptophylla.
Macauleyi.
macracantha.
melanocarpa.
mollis.
oppositifolia.
orientalis.
pallens.
Peckii.
praecox.
prunifolia.
pubescens var. stipulacea.
punctata.
semi-orbiculata.
sera.
sinaica.
succulenta.
tanacetifolia.
torva.
verecunda.
Wheeleri.

Cupressus Benthami var. arizonica.
*formosensis.
glabra.
Goveniana.
Lawsoniana.
macrocarpa.
nootkatensis.
pisifera.
thyoides.
torulosa.

Cytisus albus.
biflorus.
capitatus.
glabrescens.
Heuffeli.
horniflorus.
leucanthus.
nigricans.
— var. Carlieri.
*pallidus.
*proliferus var. palmensis (tender).
purgans.
purpureus.
Rochelii.
scoparius.
— var. Andreanus.
sessilifolius.
*stenopetalus (tender).

Daboëcia polifolia.

Daphne Mezereum.
— var. alba.

Daphniphyllum macropodum.

Davidia involucrata.

Decaisnea Fargesii.

Desmodium cinerascens.
tiliaefolium.

Deutzia compacta.
corymbosa.
crenata.
discolor var. major.
— var. purpurascens.
globosa.
glomeruliflora.
longifolia.
— var. Veitchii.
macrocephala.
planifolia.
reflexa.
Sieboldiana.
Vilmoriniae.
Wilsonii.

Diervilla Lonicera.
rivularis.
sessilifolia.

Diospyros Lotus.
— var. sylvestris.
virginiana.

Dipelta floribunda.

Distylium racemosum.

Elaeagnus argentea.
multiflora.
umbellata.

Eleutherococcus Henryi.
leucorrhizus.
— var. fulvescens.
scaberulus.
Simonii.

Elsholtzia Stauntoni.

Enkianthus campanulatus.

Erica arborea.
— var. alpina.
cinerea.
lusitanica.
Mackaii.
scoparia.
stricta.
Tetralix.

*Eucalyptus coccifera.
*MacArthuri.

Euonymus Hamiltonianus.
latifolius.
oxyphyllus.
planipes.
ussuriensis.
verrucosus.
vedoensis.

Evodia hupehensis.

Exochorda Albertii.
grandiflora var. Wilsonii.

*Fothergilla major.
*monticola.

Fraxinus coriacea.
Mariesii.
oregona.
Ornus.
parvifolia.
pennsylvanica.

Garrya elliptica.

Gaultheria procumbens.
pyroloides var. cuneata.
Shallon.

Gaylussacia dumosa.

Genista aethnensis.
cinerea.
germanica.
pilosa.
radiata.
tinctoria.
— var. elatior.
virgata.

Halesia diptera.
hispida.
tetraptera.

Hamamelis arborea.
— var. Zuccariniana.
japonica.
mollis.
vernalis.

Helianthemum alyssoides.
polifolium.
Tuberaria.
villosum.

Hydrangea aspera.
Bretschneideri.
canescens.
paniculata.
petiolaris.
radiata.
vestita.
xanthoneura.
— var. glabrescens.
— var. Wilsonii.

Hypericum Androsaemum.
aureum.
Buckleii.
elatum.
galioides.
Hookerianum.
inodorum.
Kalmianum.
patulum.
— var. Henryi.
perforatum
prolificum.
uralum.

Ilex opaca.
Pernyi.
Sieboldii.
verticillata.

Indigofera Gerardiana.

Jamesia americana.

Jasminum Beesianum.
fruticans.
humile.

Juglans nigra.

*Juniperus communis
*Lobelii.
*maritima.
*Oxycedrus.
*rufescens.
*thurifera.

Kalmia cuneata.
glauca.
latifolia.
— var. myrtifolia.

Ledum latifolium.
palustre.

Leiophyllum buxifolium.

Leucothöe racemosa.

Leycesteria formosa.

*Libocedrus macrolepis.

Ligustrum Delavayanum.
Ibota.
insulare.
japonicum.
medium.
Prattii.
Quihoui.
yunnanense.

*Lomatea ferruginea.

Lonicera alpigena.
chaetocarpa.
chrysantha.
coerulescens.
conjugalis.
deflexicalyx.
depressa.
dioica.
Ferdinandii.
floribunda.
gynochlamydea.
Henryi.
iberica.
involucrata.
— var. Ledebourii.
Kesselringii.
longa.
Maackii.
micrantha.
minutiflora.
Morrowi.
nigra.
obovata.
orientalis.
ovalis.
pileata.
prostrata.
segreziensis.
Sullivantii.
syringantha.
tatarica.
translucens.
trichosantha.
Xylosteum.

Lupinus arboreus.

Lycium pallidum.

Lyonia ligustrina.

Magnolia Lennei.
Soulangeana.
tripetala.

Meliosma cuneifolia.

Menispermum canadense.

Menziesia globularis.

Microglossa albescens.

*Morus acidosa.

Myricaria germanica.

Neillia amurensis.
opulifolia.
Ramuleyi.
stellata.
Torreyi.

Nesaea salicifolia.

Notospartium Carmichaeliae.

Nuttallia cerasiformis.

Nyssa sylvatica.

Olearia Haastii.

Ononis fruticosa.
rotundifolia.

Peraphyllum ramossimum.

Pernettya mucronata.

Pertya sinensis.

Petteria ramentacea.

Phellodendron amurense.
chinense.
sachalinense.

Philadelphus acuminatus.
brachybotrys.
californicus.
columbianus.
Gordonianus.
incanus.

Philadelphus—*cont.*
inodorus.
insignis.
latifolius.
Lewisii.
Magdalenae.
sericanthus.
speciosissimus.
tomentosus.
Wilsonii.

Phillyraea angustifolia.

Photinia variabilis.

Pieris formosa.
japonica.
mariana.

*Pinus canariensis (tender).
*Gerardiana.
*halepensis.
*luchuensis (tender).

*Pittosporum Ralphii.

Platanus acerifolia.
orientalis.

Prunus acida var. semperflorens.
cornuta.
divaricata.
incana.
japonica.
maritima.
*pennsylvanica.
*— var. saximontana.
pumila.
serotina var. salicifolia.

Pseudolarix Fortunei.

Ptelea isophylla.
trifoliata.

Pyracantha angustifolia.
coccinea.
crenulata.
— var. Rogersiana.
Gibbsii.

Pyrus alnifolia.
alpina.
americana.
—var. nana.
arbutifolia.
Aria var. majestica.
Aucuparia var. moravica.
auricularis.
Conradinae.
crataegifolia.
decurrens.
Folgneri.
Hostii.
hybrida.
kansuense.
Keissleri.
lobata.
Meinichii.
minima.
nigra.
pekinensis.
pinnatifida.
pohuashanensis.
Prattii.
prunifolia.
Ringo.
rivularis.
rotundifolia.
salicifolia.
sambucifolia.
Sargentii.
scalaris.
setschwanensis.
sikkimensis.
sorbifolia.
Sorbus.
theifera.
Toringo.
Torminalis.
Vilmorinii.
yunnanensis.
Zahlbruckneri.
Zumi.

Quercus castanaefolia.
fulhamensis.
lanuginosa.
Libani.
Mirbeckii.
rubra.

Raphiolepis japonica.

Rhamnus Alaternus.
cathartica.
davurica.
fallax.
Frangula.
japonica.
mandshurica.
utilis.

Rhododendron ambiguum.
Augustinii.
brachycarpum.
californicum.
concinnum.
decorum.
discolor.
Fargesii.
fastigiatum.
ferrugineum.
Fortunei.
halense.
hirsutum.
japonicum.
lepidotum.
maximum.
Metternichii.
micranthum.
polylepis.
punctatum.
racemosum.
rhombicum.
rubiginosum.
*Schlippenbachii.
siderophyllum.
Smirnowi.
*Tschonoskii.
Vaseyi.
viscosum.
*Weyrichii.
yanthinum.
yunnanense.

Rhodotypos kerrioides.

*Rhus orientalis.
*sylvestris.

Ribes alpinum.
cereum.
cruentum.
divaricatum.
holosericeum.
mandshuricum.

Ribes—*cont.*
petraeum.
robustum.
rotundifolium.
stenocarpum.
Warscewiczii.

Robinia Kelseyi.
neo-mexicana.

Rosa alpina.
—var. pyrenaica.
caicalensis.
coruscans.
Davidii.
—var. elongata.
elegantula.
glutinosa.
gymnocarpa.
Helenae.
Hugonis.
lucens.
Luciae.
macrophylla.
microphylla.
mollis.
Moyesii.
multibracteata.
—var. Wilsoni.
nitida.
nutkana.
omiensis.
— var. pteracantha.
pisocarpa.
rubrifolia.
Seraphinii.
sericea.
sertata.
setipoda.
sicula.
Soulieana.
spinulifolia.
Sweginzowii.
Willmottiae.
Woodsii.

Rubus adenophorus.
biflorus var. quinqueflorus.
canadensis.
chroosepalus.
coreanus.
flosculosus.
Giraldianus.

Rubus—*cont.*
illecebrosus.
inopertus.
lasiostylus.
— var. dizygos.
mesogaeus.
nigro-baccus.
nutkanus.
occidentalis.
odoratus.
omiensis.
parvifolius.
phoenicolasius.
Swinhoei.
thibetanus.
Thunbergi var. glabellus.
trianthus.
Veitchii.
xanthocarpus.

Ruta graveolens.

Schizandra chinensis.

Schizophragma hydrangeoides.
integrifolia.

Securinega fluggeoides.
ramiflora.

*Sequoia gigantea.

Skimmia japonica.

Sophora flavescens.
viciifolia.

Spartium junceum.

Spiraea Aitchisoni.
arborea.
— var. glabrata.
arcuata.
bella.
betulifolia.
bracteata.
canescens.
chamaedrifolia.
discolor.
— var. dumosa.
Henryi.
japonica.
— var. ovalifolia.

Spiraea—*cont.*
laevigata.
Lindleyi.
longigemmis.
mollifolia.
Nobleana.
Rosthornii.
salicifolia.
sorbifolia.
— var. stellipila.
tomentosa.
Veitchii.
vestita.
Wilsonii.

Staphylea colchica.
Coulombieri.
pinnata.
trifolia.

Stephanandra Tanakae.

Stewartia pentagyna.
Pseudo-camellia.

Stranvaesia Davidiana.
var. undulata.

Styrax americanum.
japonicum.
Obassia.

Symphoricarpus Heyeri.

Syringa albo-rosea.
Emodi.
japonica.
Josikaea.
Julianae.
pekinensis.
villosa.
Wilsonii.

Taxus cuspidata.

*Tecoma Reginae.

Thuya japonica.
orientalis.
plicata.

Trochodendron aralioides.

Vaccinium corymbosum.
hirsutum.
melanocarpum.
Mortinia.
neglectum.
pallidum.
Vitis-idaea.

*Viburnum acerifolium.
americanum.
betulifolium.
brevipes.
burejaeticum.
Canbyi.
cotinifolium.
Davidii.
hupehense.
ichangense.
Lantana.
lobophyllum.
ovatifolium.
*pauciflorum.
phlebotrichum.
pubescens.
rhytidophyllum.
Sargentii.
theiferum.
Veitchii.
venosum.
Wilsonii.

Wistaria chinensis.
floribunda.
multijuga.

Zanthoxylum Bungei.

Zenobia speciosa.
— var. pulverulenta.

ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX II.—1919.

LIST of STAFFS of the ROYAL BOTANIC GARDENS, Kew, and of Botanical Departments, Establishments and Officers at Home, and in India and the Colonies, in Correspondence with Kew.

* Trained at Kew. † Recommended by Kew.

Royal Botanic Gardens, Kew.—

Director	Lieut.-Col. Sir David Prain, I.M.S., C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S., F.L.S.
Assistant Director	Arthur W. Hill, M.A., Sc.D., F.L.S.
Assistant, First Class	*John Aikman.
,, ,, ,,	*William Nicholls Winn.
Keeper of Herbarium and Library	Otto Stapf, Ph.D., F.R.S. F.L.S.
Assistant, First Class	Charles Henry Wright, A.L.S.
,, ,, ,,	*Robert Allen Rolfe, A.L.S.
,, ,, ,,	*Sidney Alfred Skan.
,, Second Class	Thomas Archibald Sprague, B.Sc., F.L.S.
,, ,, ,,	Elsie Maud Wakefield, F.L.S.
,, ,, ,,	*William Bertram Turrill, B.Sc.
,, ,, ,,	*John Hutchinson.
,, for India	S. T. Dunn, B.A., F.L.S.
,, for South Africa	Amy Gertrude Corbishley, B.A.
Assistant Keeper, Jodrell Laboratory.	Leonard Alfred Boodle, F.L.S.
Keeper of Museums	John Masters Hillier.
Assistant, First Class	*John H. Holland, F.L.S.
,, Second Class	*William Dallimore.
Preparer	Laurance John Harding.

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Royal Botanic Gardens, Kew—*continued.*

Curator of the Gardens	William Watson, A.L.S.
Assistant Curator	*William J. Bean.
Foremen :—	
Herbaceous Department	*Walter Irving.
Arboretum	*Arthur Osborn.
Greenhouse and Ornamental Department.	*John Coutts.
Tropical Department	*William Taylor.
Temperate House	*Charles P. Raffill.
Storekeeper	*George Dear.

Aberdeen.—University Botanic Garden :—

Professor	——

Cambridge.—University Botanical Department :—

Professor	A. C. Seward, M.A., F.R.S., F.L.S.
Curator, University Herbarium.	——
Curator, University Museum.	H. H. Thomas, B.A.
Curator of Garden	——

Dublin.—Royal Botanic Gardens, Glasnevin :—

Keeper	Sir Frederick W. Moore, M.A., F.L.S.
Assistant	——

Trinity College Botanic Gardens :—

Professor	H. H. Dixon, Sc.D., F.R.S.

Edinburgh.—Royal Botanic Garden :—

Regius Keeper	I. B. Balfour, M.A., M.D., LL.D., Sc.D., F.R.S., F.L.S.
Assistant to Regius Keeper.	W. W. Smith, M.A., F.L.S.
Assistant (Museum)	H. F. Tagg, F.L.S.
„ (Herbarium)	W. E. Evans, B.Sc.
„ (Laboratory)	M. Y. Orr.
Head Gardener	*R. L. Harrow.
Plant Propagator	L. B. Stewart.
Assistant Gardener	D. R. Oliver.
Foremen :—	
Arboretum	A. Johnstone.
Glass Department	J. J. Campbell.
Herbaceous Department.	A. McCutcheon.

Glasgow.—Botanic Gardens :—

University Professor	F. O. Bower, M.A., Sc.D., F.R.S., F.L.S
Curator	James Whitton.

London.—Chelsea Physic Garden :—

Curator	*W. Hales, A.L.S.

Oxford.—University Botanic Garden :—

Professor	F. W. Keeble, C.B.E., F.R.S.
Curator	*William G. Baker.
Curator, Fielding Herbarium	G. C. Druce, M.A., F.L.S.

AFRICA.

Union of South Africa.—

Pretoria—Department of Agriculture :—

Chief, Division of Botany	†I. B. Pole Evans, M.A., D.Sc., F.L.S.
Mycologist - - -	Ethel M. Doidge, M.A., D.Sc., F.L.S.
„ (Herbarium) -	A. M. Bottomley, B.A.
Botanist in Charge, National Herbarium	E. P. Phillips, M.A., D.Sc., F.L.S.
Economic Botanist - -	Sydney M. Stent.

Natal Herbarium (Durban) :—

Mycologist in charge -	P. van der Bijl, M.A., F.L.S.

Department of Forests :—

Chief Conservator - -	C. E. Legat, B.Sc.

Cape Town.—National Botanic Garden :—

Director - - - -	R. H. Compton, M.A.
Curator - - - -	*J. W. Mathews.
Gardener - - - -	*A. W. Maynard.

Cape Province.—

Cape Town.—Professor of Botany, South African College — D. Thoday, M.A.

South African Museum Herbarium :—

Assistant in charge -	——
Curator, Bolus Herbarium	Mrs. F. Bolus.

Gardens and Public Parks :—

Superintendent - -	*G. H. Ridley.

Grahamstown.—Albany Museum :—

Superintendent of Herbarium.	S. Schönland, Ph.D.

Gardens and Public Parks :—

Curator - -	E. J. Alexander.
Port Elizabeth - Superintendent -	John T. Butters.
King Williamstown. Curator - - -	George Lockie.
Graaff-Reinet - „ - - -	*C. J. Howlett.
Uitenhage - „ - - -	H. Fairey.

Natal.—

Durban.—Municipal Gardens :—

Curator - - -	*H. Rutter.

Pietermaritzburg.—Botanic Garden :—

Curator - - -	*H. H. Kidd.

Transvaal.—

Pretoria.—Transvaal Museum :—

Superintendent of Herbarium.	Mrs. R. Pott.

British East Africa Protectorate.—

Nairobi - -	Director of Agriculture.	A. Holm.
	Mycologist - -	†W. J. Dowson, M.A.
	Chief of Economic Plant Division	*T. D. Maitland.

British East Africa Protectorate—*continued.*

Nairobi—*continued*—

Horticulturist - -	*C. B. Ussher.
Manager, Kabete Experimental Farm.	†A. J. Wilson.
Tropical Agricultural Instructor.	†W. H. Birchenough.
Field Assistant -	*F. B. Butler.
,, ,, -	*J. Sparrow.
Conservator of Forests -	E. Battiscombe.

Egypt.—

Cairo.—Ministry of Agriculture :—

Inspector General -	A. T. McKillop.
Botanical Section :—	
Director - - -	E. Shearer, M.A., B.Sc.
Botanist - - -	M. A. Bailey, B.A.
,, - - -	T. Trought, B.A.
Mycologist - -	H. R. Jones.
Experimental Farms :—	
Inspector - - -	M. W. Gray, M.A., B.Sc.
Horticultural Section :—	
Director - - -	*T. W. Brown, F.L.S.
Assistant Director -	*F. G. Walsingham.
Superintendent - -	*G. S. Crouch.
,,	*H. L. R. Chapman.

Gold Coast.—Agricultural Department :—

Director of Agriculture.	W. S. D. Tudhope.
Assistant Director and Mycologist.	R. H. Bunting.
Travelling Inspector	*Alfred E. Evans.
Agriculturist - -	H. G. S. Branch.
Agricultural Officer -	*W. C. Fishlock.
,, ,, - -	C. Saunders.
,, ,, - -	*A. B. Culham.
,, ,, - -	*T. Hunter.
,, ,, - -	M. D. Reece.
,, ,, - -	*G. H. Eady.
Conservator of Forests -	N. C. McLeod.

Nigeria.—

Southern Provinces.—Agricultural Department :—

Director of Agriculture.	*W. H. Johnson, F.L.S.
Assistant Director -	A. H. Kirby, B.A.
Mycologist - -	†T. Laycock.
Superintendent of Agriculture.	S. V. Henderson.
,, ,,	*F. Evans, F.L.S.
Assistant Superintendent.	A. J. Findlay, M.A., B.Sc.
,, ,,	H. G. Burr, B.Sc.
,, ,,	C. L. Silvester.
,, ,,	†G. R. Pierez.
Curator - - -	*A. R. Bell.
Director of Forests - -	H. N. Thompson.

Nigeria.—*continued.*

Northern Provinces—Agricultural Department :—

Director of Agriculture.	P. H. Lamb.
Superintendent	K. T. Rae.
Assistant Superintendent.	R. Nicol.
,, ,,	T. Thornton.
,, ,,	†L. A. Wainwright.
Senior Conservator of Forests.	J. H. J. Farquhar.

Nyasaland Protectorate.—

Zomba.—Agricultural and Forestry Department :—

Director of Agriculture.	J. S. J. McCall.
Agriculturist - -	*E. W. Davy.
,, - -	D. M. Archdale.
,, - -	H. Munro.
,, - -	†A. M. Henderson
,, - -	†D. Prain
Chief Forest Officer -	*J. M. Purves.

Rhodesia.—

Bulawayo.—Rhodes Matopos Park :—

Curator - - -	W. E. Dowsett.

Salisbury.—Department of Agriculture :—

Director - - -	E. A. Nobbs, Ph.D., B.Sc.
Agriculturist and Botanist.	H. G. Mundy, F.L.S.

Sierra Leone.—Agricultural Department :—

Director of Agriculture.	D. W. Scotland.
Assistant Director -	——
Assistant -	H. Waterland.
Conservator of Forests -	L. R. Palfreman.

Soudan.—

Khartoum -	Director of Agriculture and Forests.	Major E. B. Wilkinson.
	Superintendent of Palace Gardens.	*F. S. Sillitoe.
Jebelin - -	Superintendent of Experimental Plantations.	*T. Cartwright.

Uganda.—

Kampala—Agricultural Department :—

Director of Agriculture.	S. Simpson, B.Sc.
Botanist - - -	†W. Small, M.A., B.Sc.
District Agricultural Officer.	E. T. Bruce.
,, ,,	A. R. Morgan.
,, ,,	L. Hewett.
,, ,,	R. G. Harper.
,, ,,	*J. D. Snowden.
Assistant	*C. Hazel.
,, ,,	*P. Chandler.

Uganda—*continued.*

Entebbe—Botanical, Forestry and Scientific Department :—

	Chief Forestry Officer	*Robert Fyffe.
	Assistant - - -	W. Howells.
Zanzibar - -	Director of Agriculture.	F. C. McClellan, F.L.S.
	Assistant Director -	Robert Armstrong.
	Inspector of Plantations.	C. A. O'Connor.

AUSTRALIA.

New South Wales.—Botanic Gardens :—

Sydney - -	Director and Government Botanist.	J. H. Maiden, I.S.O., F.R.S., F.L.S.
	Superintendent -	E. N. Ward.
	Botanical Assistant -	E. Cheel.
	,, ,, -	A. A. Hamilton.
	,, ,, -	W. F. Blakeley.
	University Professor of Botany -	A. Anstruther Lawson, D.Sc., Ph.D., F.L.S.
	Technological Museum :—	
	Curator - - -	R. T. Baker, F.L.S.
	Chief Commissioner of Forests -	R. D. Hay.

Queensland.—

Brisbane.—Botanic Gardens :—		
	Government Botanist-	C. T. White.
	Curator - - -	E. W. Bick.
	Acclimatisation Society's Gardens :—	
	Secretary - - -	L. G. Corrie, F.L.S.
	Manager - - -	R. W. Peters.
	Commissioner of Forests -	N. W. Jolly, B.A., B.Sc.
Cairns.—Instructor in Tropical Agriculture.		——
	Kamerunga State Nursery :—	
	Manager - - -	C. E. Wood.
Rockhampton -	Superintendent - - -	R. Simmons.

South Australia.—

Adelaide.—University Professor of Botany.		T. G. B. Osborn, M.Sc.
	Botanic Gardens :—	
	Director - - -	J. F. Bailey.
	Woods and Forests :—	
	Conservator - -	Walter Gill, F.L.S.

Northern Territory.—

Port Darwin.—Botanic Gardens :—		
	Curator - - -	*C. E. F. Allen.

Tasmania.—

Hobart - -	Government Botanist	Leonard Rodway, C.M.G.
	Chief Forests Officer -	J. C. Penny.
	Botanic Gardens :—	
	Superintendent - -	J. Wardman.

Victoria.—

Melbourne.—Botanic Gardens :—		
	Director - - -	J. Cronin.

Victoria—*continued.*

Melbourne (*continued*).—National Herbarium :—

Government Botanist and University Professor of Botany.	A. J. Ewart, D.Sc., Ph.D., F.L.S.
Conservator of Forests - - -	H. R. Mackay.

Western Australia —

Perth.—Department of Agriculture :—

Botanist and Pathologist.	F. Stoward, D.Sc.

Department of Woods and Forests :—

Inspector General -	C. E. Lane Poole.

BERMUDA.

Agricultural Department :—

Director - - - - - -	E. J. Wortley, F.C.S.

CANADA.

Ottawa - -	Director of Government Experimental Farms.	J. H. Grisdale.
	Dominion Horticulturist.	W. T. Macoun.
	Dominion Botanist -	——
	Assistant - - -	J. Adams.
	„ - - -	F. Fyles, B.A.

CEYLON.

Peradeniya.—Department of Agriculture :—

Director of Agriculture - - -	†F. A. Stockdale, M.A., F.L.S.
Botanist and Mycologist- - -	†T. Petch, B.A., B.Sc.
Economic Botanist - - -	†F. Summers.
Assistant Botanist and Mycologist -	†G. Bryce, M.A., B.Sc.
Manager, Peradeniya Experiment Station.	G. Harbord.
Superintendent of Botanic Gardens	*H. F. Macmillan.
Curator of Royal Botanic Gardens, Peradeniya.	*T. H. Parsons.
Curator, Hakgala Gardens - -	*J. J. Nock.
Plant Diseases Inspector (Mycological).	†E. A. Gadd.
Conservator of Forests - - -	H. F. Tomalin.

CYPRUS.

Principal Forest Officer - -	A. K. Bovill.
Director of Agriculture - -	W. Bevan.

FALKLAND ISLANDS.

Government House Garden :—

Head Gardener - - - - -	*A. W. Benton.

FIJI.

Superintendent of Agriculture and Curator, Botanic Station.	Hon. Charles H. Knowles, B.Sc.

HONG KONG.

Botanic and Forestry Department :—

Superintendent	*W. J. Tutcher, F.L.S.
Assistant Superintendent	*H. Green.

MALTA.

Inspector of Agriculture	Francesco Debono, M.D.
Superintendent of Public Gardens	J. Borg, M.D.

MAURITIUS.

Reduit.—Department of Agriculture :—

Director	H. A. Tempany, B.Sc., F.I.C., F.C.S.
Assistant Director	†G. G. Auchinleck, B.Sc.
Agricultural Instructor	——

Port Louis.—Department of Forests :—

Director	Paul Koenig.

NEW BRITAIN.

Rabaul.—Department of Agriculture :—

Director	H. O. Newport.

Botanic Gardens :—

Superintendent	R. A. Hopkins.

NEW ZEALAND.

Dunedin	Superintendent	*D. Tannock.
Napier	„	W. Barton.
Auckland	Ranger	William Goldie.
Christchurch	Head Gardener	J. Young.

SEYCHELLES.

Botanic Station :—

Curator	P. R. Dupont.

MALAY PENINSULA.

Straits Settlements.—Botanic Gardens :—

Singapore -	Director - - - -	†I. H. Burkill, M.A., F.L.S.
	Assistant Director - -	*T. F. Chipp, B.Sc., F.L.S.
	Assistant Curator - -	*F. Flippance.

Federated Malay States.—Forest Department :—

Conservator - -	G. E. S. Cubitt.

Kuala Lumpur.—Agricultural Department :—

Director of Agriculture.	L. Lewton-Brain, B.A., F.L.S.
Assistant to Director	†F. de la M. Norris.
Chief Agricultural Inspector.	†F. W. South, B.A.
Assistant Inspector -	*F. Birkinshaw.
Agriculturist - -	†F. G. Spring, F.L.S.
,, - -	B. Bunting.
Agricultural Instructor	†H. W. Jack, B.A., B.Sc.
,, ,,	†D. H. Grist.
Mycologist - -	†A. Sharples.
Assistant Mycologist -	†H. H. Stirrup.
Physiologist - -	†W. N. C. Belgrave, B.A.
Economic Botanist -	——
Assistant ,, -	*W. N. Sands, F.L.S.
Superintendent Government Plantations.	*J. N. Milsum.

Perak (Taiping).—Government Gardens and Plantations :—

Superintendent - -	L. M. Berenger.

Selangor and Negri Sembilan.—

Superintendent - -	*J. Lambourne.

WEST INDIES.

Imperial Department of Agriculture :—

Barbados - -	Commissioner - -	Sir Francis Watts, K.C.M.G., D.Sc., F.I.C., F.C.S.
	Scientific Assistant -	W. R. Dunlop.
	Mycologist - -	W. Nowell, B.A., B.Sc.
Antigua.—Government Chemist and Superintendent of Agriculture, Leeward Islands.		A. E. Collens, F.C.S. (Acting).
Botanic Station :—		
	Curator - - -	——
	Agricultural Assistant	V. Pereira.
	,, ,,	H. E. McDonald.
	,, ,,	E. C. T. Michael.
	,, ,,	E. Eldridge.

Barbados.—Department of Agriculture :—

Superintendent -	J. R. Bovell, I.S.O., F.L.S., F.C.S.
Assistant Superintendent.	C. L. C. Bourne, B.Sc.

Dominica.—Botanic Station :—

Curator - -	*Joseph Jones.
Assistant Curator and Assistant Chemist.	*Alfred Keys.

Grenada.—Botanic Garden :—

Agricultural Superintendent.	*R. O. Williams.
Agricultural Instructor	W. O. Donovan.
„ „	E. L. Cherubim.

Montserrat.—Botanic Station :—

Curator - - -	*W. Robson.
Assistant Curator -	A. W. Gallwey (Acting).

St. Kitts-Nevis.—Botanic Station :—

Agricultural Superintendent.	F. R. Shepherd.
Agricultural Instructor, Nevis.	W. I. Howell.

St. Lucia.—Botanic Station :—

Agricultural Superintendent.	*A. J. Brooks, F.L.S., F.C.S.
Agricultural Assistant -	E. L. Beaubrun.

St. Vincent.—Botanic Station :—

Agricultural Superintendent.	*T. Jackson.
Assistant Agricultural Superintendent.	S. C. Harland, D.Sc.

Virgin Islands.—Botanic Station :—

Curator - - -	——

British Guiana.—Department of Science and Agriculture :—

Georgetown -	Director - - -	Prof. J. B. Harrison, C.M.G., M.A., F.I.C., F.C.S.
	Assistant Director -	†G. E. Bodkin, B.A.
	Mycologist - -	†F. Stell.
	Horticultural Superintendent.	A. A. Abraham (Acting).
	Superintendent of Botanic Gardens and Agricultural Stations.	*Robert Ward.
	Superintendent of Sugar Experiment Stations.	J. Crabtree.
	Forestry Officer - -	L. S. Hohenkerk.

British Honduras.—Botanic Station :—

Curator - - -	Eugene Campbell.

Jamaica.—Department of Agriculture :—

Director - - -	Hon. H. H. Cousins, M.A., F.C.S.
Travelling Instructor	*William Cradwick.
„ „	James Briscoe.

Public Gardens and Plantations :—

Superintendent -	*William Harris, F.L.S.
Superintendent of Experiment Station.	P. W. Murray.

Tobago.—Botanic Station :—

Curator - - - - - -	H. Meaden.

Trinidad.—Department of Agriculture :—

Director - - -	W. G. Freeman, B.Sc., F.L.S.
Assistant Director -	J. de Verteuil (Acting).
Curator, Royal Botanic Gardens.	——
Horticulturist and Assistant Botanist.	*W. E. Broadway.
Forest Officer - - -	C. S. Rogers.

INDIA.

Botanical Survey of India :—

Director - - - - -	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc., F.L.S.
Economic Botanist - - -	†H. G. Carter, M.B., Ch.B.
Assistant for Phanerogamic Botany	M. S. Ramaswami, M.A.
„ „ „	P. M. Debburman, B.Sc.

Departments of Agriculture, Botanical Officers attached to :—

Imperial Agricultural Research Institute, Pusa, Bengal :—

Mycologist - - - -	†E. J. Butler, M.B., F.L.S.
Assistant Mycologist - -	F. J. F. Shaw, B.Sc., F.L.S.
Economic Botanist - -	A. Howard, C.I.E., M.A., F.L.S.
Supernumerary Botanist -	——

Departments of Agriculture, Botanical Officers attached to—*continued.*

Bengal Agricultural Department, Calcutta :—

Economic Botanist - - G. P. Hector, M.A., B.Sc.

Bihar and Orissa :—

Economic Botanist and Principal, Sabour Agricultural College. ——

Bombay Agricultural Department, Poona :—

Economic Botanist - - †W. Burns, D.Sc.

Central Provinces Agricultural Department, Nagpur :—

Economic Botanist - - †R. J. D. Graham, M.A., B.Sc.

Madras Agricultural Department :—

Government Sugarcane Expert, Agricultural College, Coimbatore. ——

Lecturing Botanist - - K. Rangachari, M.A.

Mycologist - - - - †W. McRae, M.A., B.Sc., F.L.S.

Punjab Agricultural Department, Lyallpur :—

Economic Botanist - - †D. Milne, B.Sc.

United Provinces Agricultural Department, Cawnpur :—

Economic Botanist - - †H. M. Leake, M.A. F.L.S.

BENGAL.

Calcutta.—Royal Botanic Garden, Sibpur :—

Superintendent - - - - Major A. T. Gage, I.M.S., M.A., M.B., B.Sc., F.L.S.

Curator of Herbarium - - - †C. C. Calder, B.Sc., F.L.S.

Curator of Garden - - - *G. T. Lane.

1st Overseer - - - - - N. Mitra.

2nd Overseer - - - - - M. Jones.

Probationer - - - - - ——

Gardens in Calcutta :—

Assistant Curator - - - - *P. V. Osborne.

Overseer - - - - - - S. N. Bose.

Agri-Horticultural Society of India :—

Secretary - - - - - S. P. Lancaster.

Darjeeling.—Lloyd Botanic Garden :—

Superintendent - - - -	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc. F.L.S.
Curator - - - - - -	*G. H. Cave.

Cinchona Department.—

Superintendent of Cinchona Cultivation.	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc. F.L.S.

Mungpoo Plantation :—

Manager - - - - -	*P. T. Russell.
1st Overseer - - - - -	P. Cresswell.
2nd Overseer - - - - -	James Hulbert.

Munsong Plantation :—

Manager - - - - -	*H. F. Green.
Assistant Manager - - - -	*H. Thomas.
Overseer - - - - -	G. Holl.

Dacca (Ramna).—

Arboricultural Adviser to Government of Bengal.	——

BOMBAY.

Bombay City.—Municipal Garden :—

Superintendent - - - -	J. M. Doctor.

Ghorpuri.—Botanic Garden :—

Superintendent - - - -	P. G. Kanetkar.

Poona.—Government Gardens :—

Superintendent - - - -	*E. Little.

CENTRAL PROVINCES.

Nagpur.—Public Gardens :—

Superintendent - - - -	*J. E. Leslie.

MADRAS.

Madras City.—Government Gardens and Parks :—

Superintendent - - - -	*W. V. North.

Agri-Horticultural Society :—

Superintendent - - - -	H. E. Houghton, F.L.S.

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